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Evaluation of the Integrated Contact-Instrument Concept for Army Fixed Wing Flight Instruction

by

Wallace W. Prophet and Oran B. Jolley

HumRRO Division No. 6 (Aviation)

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FOREWORD

The objective of Work Unit INTACT was to evaluate the effectiveness of the Integrated Contact-Instrument Flight Training concept in Army fixed wing primary flight training. The experimental flight training classes received their instruction at the U.S. Army Aviation School during the 1961-62 period, and the results were conveyed to the Army for action consideration.

The purpose of this report, which documents some of the results of that study is to make the findings available to a wider audience, in view of the continuing importance of instrument flight training. Another factor related to issuance of the present report is the Army's change in primary training aircraft. At the time this study was made, fixed wing primary flight training was administered in the O-1 aircraft, which was not a suitable aircraft for implementation of integrated training; the Army now uses the T-41 aircraft, which would be suitable for such training.

In the conduct of this study, the cooperative effort of a large number of military and civilian personnel was necessary. In particular, the suggestions and cooperative support of the military checkpilots of the Department of Primary Fixed Wing Training and the civilian primary flight instructors of Hawthorne Aviation were important to the success of the study.

The INTACT research was performed by HumRRO Division No. 6 (Aviation) at Fort Rucker, Alabama. The research was performed and most of the report preparation completed while HumRRO was part of The George Washington University. The Director of HumRRO Division No. 6 is Dr. Wallace W. Prophet, who was also Work Unit Leader at the time the INTACT research was conducted. Dr. J. Daniel Lyons was Director of Research at that time. In addition to the authors, Mr. Maurice Siskel, Mr. William B. Boney, and Mr. H. Alton Boyd, Jr., of HumRRO Division No. 6 made significant contributions to the study.

Military support for the study was provided by the U.S. Army Aviation Human Research Unit. COL Arne H. Eliasson was Unit Chief at the time the research was conducted. LTC Ralph V. Gonzales is the present Unit Chief.

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Meredith P. Crawford
President
Human Resources Research Organization

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HUMAN RESOURCES RESEARCH ORGANIZATION

Technical Report 69-26
Work Unit INTACT

The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation. HumRRO's mission in work performed under contract with the Department of the Army is to conduct research in the fields of training, motivation, and leadership.

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MILITARY PROBLEM

Army aviation has witnessed a constant evolution in terms of mission and flight skill requirements. Early Army aircraft could be flown only under contact conditions, that is, the pilot controlled the aircraft by visual reference (or contact) to the outside world. During the past 15 years, however, the requirement has emerged for Army aircraft to fly under instrument conditions, that is, the pilot controls the aircraft solely by reference to the cues provided by the various instruments in the cockpit. Accordingly, the Army has sought better and more efficient training methods for the teaching of instrument flight skills and the other flight skills needed by the aviator.

While the need for instrument flight skills in rotary wing aircraft is receiving much current attention, the operational requirement for instrument flight skills was first manifest in fixed wing flying. One training method which showed promise was that known as the *Integrated Contact-Instrument Flight Training Concept*, and the Army requested an experimental evaluation of this training method. In the planning of the evaluation, another question of importance arose—the relative advantages of alternative cockpit seating arrangements of the student and instructor. Accordingly, the study also involved a comparison of side-by-side seating and tandem-seating training aircraft.

RESEARCH PROBLEM

The research reported here was aimed at determining the following:

(1) Relative levels of proficiency in primary flight maneuvers of students trained under (a) integrated primary training, or (b) the standard non-integrated primary training.

(2) Training attrition rates for integrated and non-integrated primary training methods.

(3) Effects of integrated training on early contact flight proficiency.

(4) Relative levels of proficiency in advanced contact and advanced instrument flight maneuvers of students trained under the two primary training methods described.

In addition to the contact-instrument training questions, a fifth question was addressed—that of the relative performance of students receiving primary flight training in a side-by-side seating aircraft and in the tandem-seating aircraft which was then standard.

APPROACH

Three groups of 36 students each received U.S. Army primary flight training, each group under a different aircraft - training method program, and their performances in primary, advanced contact, and advanced instrument training phases were compared. The three groups were randomly constituted from two Officer Fixed Wing Aviator Course classes from company grade officers with no or minimal previous flight experience.

One group (identified in this report as I/SS) received the experimental *integrated* primary training program in a leased *side-by-side* seating aircraft; the second group (NI/SS) received the standard *non-integrated* primary training program in the leased *side-by-side* seating aircraft; and the third group (NI/T) received the standard *non-integrated* primary training program in the Army's then standard *tandem*-seating primary

training aircraft. The only experimental manipulations or changes were in the primary training phase which was 120 flight hours (including 32 hours of instrument training) and 16 calendar weeks in length. All three groups received standard training in the aircraft which were then standard during the advanced contact and advanced instrument phases of training.

In addition to the regularly available subjective measures of flight performance, special objective measures of both daily and checkride flight performance were obtained for all students. These and measures of training attrition and time-to-checkride constituted the criteria for evaluating the effectiveness of the three primary aircraft - training method combinations studied.

RESULTS

Differences in favor of students trained by the integrated method over non-integrated students were found for subjective checkride grades at the 75- and 120-hour levels during primary training. However, these differences, while statistically significant, would not seem to be of major practical significance. No other indices of performance, including flight attrition, showed statistically significant differences between these two methods. It should be noted that the relatively small numbers of subjects involved would generally necessitate fairly large differences in order to reach the required size for statistical significance.

There were no detrimental effects on early contact flight proficiency resulting from integrated training, and the integrated and non-integrated students did not differ significantly in their flight proficiency during either of the advanced training phases.

Students trained in the side-by-side seating aircraft exhibited better flight performance, on practically all flight measures, than did those who received their primary training in the tandem-seating aircraft. However, these differences were statistically significant on less than half of the measures reported.

CONCLUSIONS

On the basis of the results of the study it is concluded that:

(1) Integrated contact-instrument primary flight training produces gains in primary maneuver flight proficiency.

(2) The advantages in flight proficiency possessed by integrated students during their primary training are not manifest in their performances during advanced flight training phases.

(3) Students receiving primary training in side-by-side seating aircraft show higher flight proficiency throughout training than do those receiving primary flight training in a tandem-seating aircraft.

CONTENTS

	Page
Background and Approach	3
Army Aviation and Instrument Flying	3
Integrated Contact-Instrument Flight Training	4
Considerations Involved in Designing the Study	5
Type of Aircraft	5
Flight Proficiency Measurement	6
Research Problem and Procedures	9
Research Questions	9
Experimental Design	10
Selection of Students	11
Training	12
Data Collection	12
Results	13
Primary Phase	13
Attrition	13
Flight Time	14
Instructor Evaluation Grades	15
Checkride Grades	16
Miscellaneous	17
Advanced Contact Phase	18
Attrition	18
Flight Time	18
Instructor Evaluation Grades	18
Checkride Grades	18
Miscellaneous	19
Advanced Instrument Phase	20
Attrition	20
Flight Time	20
Instructor Evaluation Grades	20
Checkride Grades	20
Miscellaneous	20
Discussion and Conclusions	22
Literature Cited	27
Appendices	
A Primary Phase Pilot Performance Description Record	29
B Primary Phase Daily Progress Record (DPR)	53
C Advanced Contact Phase Daily Progress Record (DPR)	62
D Advanced Instrument Phase Daily Progress Record (DPR)	75
E Experimental Flight Syllabus: Integrated Contact-Instrument Primary Flight Training	88
F DPR Learning Curves for Selected Primary Flight Maneuvers	96

Tables

		Page
1	Number of Students by Class and Primary Training Condition	10
2	Means and Ranges for AFWAB Scores by Experimental Group and Class	12
3	Schedule and Content of Flight Checkrides	13
4	Number of Students Completing Each Stage of Primary Training	14
5	Mean Flight Time (Total, Contact, Instrument, and Solo) by Primary Training Stage	14
6	Instructor Evaluation Grades by Stage of Primary Training	15
7	Checkride Grades by Stage of Primary Training	16
8	PPDR Errors by Stage of Primary Training	17
9	Checkride Grades by Stage of Advanced Contact Training	18
10	PPDR Percent Error by Stage of Advanced Contact Training	19
11	Checkride Grades by Stage of Advanced Instrument Training	21
12	PPDR Percent Error by Stage of Advanced Instrument Training	21
A-1	Maneuvers and Total Possible Errors for Primary PPDRs	30
A-2	Scale Items	31

Figures

A-1	Normal Take-Off	33
A-2	Straight and Level	34
A-3	Two 90° Climbing Turns	36
A-4	Spins	38
A-5	Entry to and Flying Traffic Pattern, and Normal Landing	39
A-6	Forced Landing	43
A-7	Instrument Take-Off	46
A-8	Timed Turns	48
A-9	Unusual Attitude Recovery	50
A-10	Changing Airspeed in Level 180° Turns	52
B-1	Normal Take-Off	54
B-2	Straight and Level	54
B-3	90° Climbing Turns	55
B-4	Power-Off Spins	55
B-5	Traffic Pattern and Landing	56
B-6	Forced Landing	58
B-7	Instrument Take-Off	59
B-8	180° Timed Turns	60
B-9	Unusual Attitude (Diving Spiral)	60
B-10	Unusual Attitude (Steep Climbing Turn)	61
B-11	Changing Airspeed Level 180° Turns	61
C-1	Stagefield	63
C-2	Strip Landing	65
C-3	Road Landing	68
C-4	Maximum Performance Take-Off	71
C-5	Forced Landing (500 Feet or Above)	73

Figures Page

Figure	Title	Page
C-6	Forced Landing (Under 500 Feet)	74
D-1	Instrument Take-Off	75
D-2	Timed Turns	76
D-3	Compass Turns	77
D-4	Steep Turns	78
D-5	180° Climbing Turns	79
D-6	180° Descending Turns	80
D-7	Unusual Attitude (Steep Climbing Turn)	81
D-8	Unusual Attitude (Diving Spiral)	82
D-9	Radio VOR	83
D-10	Radio ADF	84
D-11	Radio GCA	85
D-12	Radio ILS	86
D-13	Cross Country	87
F-1	Mean Percent Error by Total Flight Time: Maneuver No. 1, Take-off	96
F-2	Mean Percent Error by Total Flight Time: Maneuver No. 5, Level Turns	96
F-3	Mean Percent Error by Total Flight Time: Maneuver No. 8, Slow Flight	97
F-4	Mean Percent Error by Total Flight Time: Maneuver No. 11, Traffic and Landing	97
F-5	Mean Daily Flight Grade by Total Flight Time: Maneuver No. 1, Take-off	98
F-6	Mean Daily Flight Grade by Total Flight Time: Maneuver No. 5, Level Turns	98
F-7	Mean Daily Flight Grade by Total Flight Time: Maneuver No. 8, Slow Flight	99
F-8	Mean Daily Flight Grade by Total Flight Time: Maneuver No. 11, Traffic Landing	99

Evaluation of the Integrated Contact-Instrument Concept for Army Fixed Wing Flight Instruction

BACKGROUND AND APPROACH

ARMY AVIATION AND INSTRUMENT FLYING

The years that have elapsed since the birth of Army Aviation in World War II have witnessed steady and progressive change in Army Aviation. Missions have grown in number and scope. Equipment complexity has increased considerably, particularly in the past five years. With these developments has come an increasing emphasis on instrument flying.[1] It has come to be accepted that if Army Aviation is to meet its ever-increasing responsibilities, it must come closer to having an all-weather capability. Achieving real all-weather capability is perhaps an impossible goal, but acquiring a capability during adverse or marginal weather conditions is within reach and is vitally necessary to Army Aviation.

It is not the purpose of this report to discuss whether Army Aviation should or does have "all-weather," "semi-all-weather," or "marginal-weather" capability. It is sufficient for present purposes to note that each of these capabilities demands that the Army Aviator receive some form of instrument training.

With this sort of background, interest in, and emphasis on, instrument training for the Army Aviator has been increasing. This interest was manifest first in the fixed wing training program. During the past few years a similar interest has been shown in rotary wing instrument flying. Whereas the Army Aviator was formerly graduated and rated as an Aviator with only a contact flight capability, for a number of years the fixed wing aviator has been given instrument training routinely and receives his instrument rating before going to the field. More recently, rotary wing student pilots have also been given instrument training and receive a tactical instrument rating.

With a view toward the increasing requirement for conducting instrument training, the U.S. Army Aviation School has been interested in possible techniques for improving the quality of instrument instruction given the Army Aviator. One such technique became known as the *Integrated Contact-Instrument Flight Training Concept*, an approach to flight training developed principally at the University of Illinois. Their research experience (1) with this type of training indicated it to be a very promising approach for the Army to investigate. Some of the research antecedents for the Illinois study, as well as several subsequent studies, have been summarized by Jolley (2).

As a result of the work done at Illinois, the Army Aviation School in 1957 conducted a small-scale feasibility study of integrated instruction in Army Aviation fixed wing training. The results of that study (3) looked promising enough that in 1957 the Army Aviation School made formal request that HumRRO Division No. 6 (Aviation)[2] conduct a large-scale evaluation of integrated training in Army Aviation primary fixed wing training. As a result, Work Unit INTACT was initiated. This report presents the results of that evaluation.

[1] In instrument flying the pilot controls the aircraft solely by reference to the cues provided by the instruments in the cockpit. Such flight can be contrasted with *contact* flying in which the cues for control are provided by visual reference to the ground and horizon.

[2] Then the Army Aviation Detachment of the Training Methods Division, Human Resources Research Office.

The research reported here was performed in 1960-61 and the results were reported to the Army for action purposes. The purpose of issuing the present report is twofold: First, because of the interest in the integrated training concept which exists in the civilian flight community (4), it is desirable that these research results be placed in the open literature. Second, changes have taken place within Army fixed wing flight training which lend possible new operational implications to these results.

At the time this research was conducted the Army was administering all of its primary fixed wing training in the O-1 Bird Dog, a two-place, tandem-seating aircraft. This aircraft was not suitable as a vehicle in which to implement integrated flight training, and the prevailing Army view did not favor acquisition of a new training aircraft. Later, there was a change in this view, and the Army acquired a fleet of T-41s—four-place, side-by-side seating aircraft. Reconsideration of the pros and cons of the integrated training concept is now advisable, since it would be quite feasible to implement integrated training in the T-41.

INTEGRATED CONTACT-INSTRUMENT FLIGHT TRAINING

Flight instruction seems traditionally to have been given in the following sequence: contact day; contact night; and instrument. This sequence may have arisen as a result of the fact that this was the historical sequence in which these types of flying developed. At any rate, the idea seems to have come about that one must first master contact flying before being competent enough to tackle the more complex instrument flying. This philosophy has also resulted in what is sometimes labeled as "block" or "sandwich" training, that is, instrument and contact training given in separate "blocks" of instruction with a "sandwich" result. Thus, the flight training sandwich usually begins with a liberal "slice" of contact flying, followed by varying slices of instrument and contact flying. The research previously referred to, particularly that of Ritchie and Michael (5), has called into serious question the efficiency of this means of administering contact and instrument flight instruction.

The integrated approach to flight training seeks to treat contact and instrument flying as two different aspects of a single entity, rather than treating them as completely separate and distinct ways of piloting an aircraft. The integrated training concept reasons that contact and instrument flying are quite similar in terms of the responses made by the pilot, differences being principally in magnitude rather than kind of response. The principal difference between the two types of flying is in the stimuli, or cues, to which the responses are made.

In contact flying the principal source of information (cues) is the pilot's perception of the relationship between his aircraft and the ground and horizon. His source of information, then, is his visual perception of the outside world—that is, visual contact. In instrument flying the only source of information which the pilot has is that provided by the various instruments in the cockpit. The information is still presented visually, but it is in coded form. While it is possible (and perhaps even advantageous) to teach the student-pilot to respond directly to the instrument cues without any intervening percept of aircraft attitude or orientation, most instrument-flight instruction attempts to teach the student to translate the instrument cues into the corresponding mental image, or perception, of aircraft attitude. Having thus interpreted the instrument cues into the appropriate picture of attitude, the student is then able to respond in whatever fashion is necessary to keep the aircraft in, or return it to, the desired flight state or attitude.

Most pilots feel instrument flight is more difficult than contact flight, and, indeed, research has shown that the process of learning to translate instrument cues into the appropriate perception and response is more difficult than that of learning to utilize

contact cues alone (5, 6). One of the assumptions made by the integrated training concept is that this process of translation is made less difficult if a systematic attempt is made to associate these two sets of cues, both conceptually and in time. In short, the idea is to integrate the two types of information sources, contact and instrument, so that the translating process is learned simultaneously with the responses to be made.

The following procedures and guidelines were followed in devising and administering integrated training in this study:

(1) Maneuvers were first introduced to the student under simulated instrument conditions. The method used to simulate instrument conditions while inflight was the usual one of having the student wear a "hood" which did not permit him to see the ground or other extra-cockpit visual cues. This was done to take advantage of the positive transfer effect from instrument to contact flight reported by Ritchie and Michael (5).

(2) After having been exposed to the maneuver under instrument conditions, the student was then shown the maneuver under contact conditions. The relationship between instrument and contact cues was pointed out to the student.

(3) Subsequent practice of the maneuver during the flight period involved some trials with only instrument cues available and some emphasizing contact cues. Most of the flight time, which was recorded as contact time in the flight log, laid stress on the use of both sets of cues available to the student (instrument and contact) in integrated fashion. That is, the student was urged while flying under contact conditions to utilize the full gamut of information about aircraft attitude and status available to him. This, of course, included both contact and instrument cues.

CONSIDERATIONS INVOLVED IN DESIGNING THE STUDY

Considerable planning was necessary before the study could be initiated. The factors judged to be of greatest importance to the design of the study were type of aircraft to be used in primary flight training and techniques for measuring flight proficiency.

Type of Aircraft

The considerations involving aircraft type have been summarized by [illegible]lley (2). As a result of those considerations it was decided that the primary fixed wing training aircraft then used by the U.S. Army—the O-1—was not a suitable vehicle in which to administer integrated training. The O-1 provided tandem seating for the instructor and student and, for that reason, did not lend itself to an integrated type of training. For safety reasons, the student is not permitted to fly the O-1 by sole reference to instruments from his front seat position (even though he has a full panel of instruments available to him). Furthermore, the instructor has no instrument panel in his rear seat position.[3] It was therefore recommended that the Army lease for use in the study a sufficient number of civilian aircraft with provision for side-by-side seating.

As a result arrangements were made to lease 16 civilian Cessna Model-180 aircraft[4] which have side-by-side seating and the necessary equipment for instrument flight instruction. The

[3] Three models of the O-1 aircraft were used in primary training. The O-1A and O-1E models, used for all contact flying, are standard Army tactical observation aircraft, and the instrument panel configuration is as described. However, instrument instruction was administered in the TO-1D model, in which both front and rear cockpits possess full instrument panels. The student flew in the rear cockpit with all outside cues removed by the use of curtains or other light shielding. In addition, the TO-1D differed in that it had a variable pitch propeller.

[4] Both the C-180 and the O-1 aircraft are manufactured by the Cessna Aircraft Company. Identification of trade names is for purposes of research documentation only and does not imply endorsement by the Army or the Human Resources Research Organization.

Army selected this aircraft because of its similarity to the O-1.[5] Its utility in this regard was enhanced by the fact that many of the parts required in maintaining the aircraft were interchangeable with those for the O-1, thereby reducing maintenance costs to a minimum.

Flight Proficiency Measurement

Considerations involving techniques for measuring flight proficiency were somewhat more involved. A number of previous research studies had pointed up the deficiencies of the traditional subjective methods for rating pilot proficiency. These studies have been summarized by Ericksen (7) and Greer, Smith, and Hatfield (8). Particularly as a result of the evidence cited by Greer *et al.*, it was decided that before the study of integrated training could be conducted it would be necessary to develop more objective methods of measuring flight proficiency.

The recording forms developed for the collection of flight-performance data in Work Unit INTACT were modeled after those developed by Smith, Flexman, and Houston (9) and by Greer *et al.* (8). Two general forms were developed—the Daily Progress Record (DPR), for use by the instructor in recording daily performance of flight maneuvers, and the Pilot Performance Description Record (PPDR), for use by the checkpilot in recording performance on the periodic tests, or checkrides, of flight proficiency given throughout the training program.

The DPR and PPDR differed from one another principally in terms of the amount and level of detail required. The general goal in development of these forms was to provide a maneuver description that was as complete as possible, and as objective as possible. The emphasis was on using the instructor or checkpilot primarily as an observer and recorder, in distinction to his usual role of evaluator. This is to say not that evaluation was ignored, but that the emphasis was placed on standardized observation and recording of specified events and indices that form the basis for evaluation.

The first step involved in constructing the PPDR (from which the DPR was derived) was the careful analysis of each of the maneuvers in the primary flight curriculum, to determine the exact performance steps required by the maneuver and the indices available to the student and instructor or checkpilot for determining adequacy of performance. This resulted in a series of performance items which define the maneuver. To the extent possible, these items were based on objective referents—readings from instruments such as airspeed, altitude, angle of bank, and degrees turned. These items are described as "scale items," items capable of continuous variation over a scale of values. In distinction to the scale items were items that reflected behaviors that were discrete rather than continuous. These items can be thought of as categorical or "yes-or-no" type items, which the student either did or did not perform correctly. Examples of such items are, "looks before initiating turn," and "selected proper field for forced landing." Many of the discrete type items were based on factors that were, in fact, continuous, but that could not be evaluated as such. For example, the item "ground track" is marked as being either "proper" or "not-proper" even though the state of being "not-proper" is a continuous variable—due to the extreme difficulty involved in specifying exact objective referents as required by scale items.

After the initial definition of performance items, derived from conferences with experienced instructors and appropriate training literature, the items were assembled into a preliminary form. The form was then tried out inflight to determine problems of administration. The necessity for highly skilled personnel to administer such data forms

[5] One principal difference between the C-180 and the O-1A and O-1E models was that the former has a variable pitch propeller, whereas the two O-1 models have fixed pitch propellers.

has been emphasized by Smith, Flexman, and Houston (9), Greer, Smith, and Hatfield, (8), and Duffy and Colgan (10). The administration of the INTACT PPDRs by skilled instructors and checkpilots revealed a number of difficulties. The items and forms were revised and refined through successive cycles to achieve a set of items that were capable of observation and recording inflight by a skilled pilot, and that were complete enough to cover the important aspects of the flight maneuver. Four revisions were made before achieving the final draft form that would be used by the instructors and checkpilots in the INTACT study.

In order to carry out the above efforts it was necessary to equip the O-1A and O-1E aircraft, which were used in this preliminary work, with an instrument panel in the rear seat which the instructor or checkpilot could refer to during flight. The panel contained an attitude indicator, airspeed indicator, altimeter, heading indicator, and turn-and-slip indicator. Since the experimental design of the study required the use of O-1 aircraft in addition to the leased side-by-side aircraft, 16 O-1 planes were so equipped.

Eight different PPDR forms were developed for use in Work Unit INTACT during the primary phase of training. Eight were necessary because four checkrides are given during primary training, and a different form was necessary for each of the two types of aircraft, the O-1 and the side-by-side C-180. Specimen pages from the Primary Phase PPDR forms are shown in Appendix A. These specimens show the general types of performance items used—the scales and discrete items—as well as the general format utilized.

After the PPDRs were finalized, the DPRs were constructed from them. In the DPR all items are represented in the discrete or yes-no form. The purpose of this was to simplify the form so that the instructor would not be unduly burdened with data-gathering duties during his daily instruction periods. As a further simplification, the instructor was requested to record only the *first* attempt at each maneuver performed on a given day. Thus, whereas the PPDR is a more-or-less complete record of all events that occur during the checkride, the DPR provides only a sampling of daily performance. Specimen pages from the Primary DPR are shown in Appendix B.

The next step involved an extensive training program in the use of the PPDR and DPR for the relatively large number of instructors and checkpilots who would take part in the study. The training program for these personnel required about six months prior to the start of the experiment and turned out to be a continuing requirement throughout the course of the study because of personnel turnover, promotions, and so forth.

The training program for PPDR and DPR usage involved three general activities. The first consisted of ten hours of classroom instruction, which covered the general background and rationale for the INTACT study, detailed discussion of the derivation and use of the PPDR and DPR forms, and the reasons for and importance of objective flight performance information. Considerable group discussion took place during these classes, and flight personnel made many valuable suggestions which resulted in changes and modifications to the forms and procedures for their use. Much time was devoted to discussing scale and discrete items and standardizing the tolerances and referents on the basis of which performance was to be recorded.

The second training activity was inflight practice in administering the PPDR and DPR forms with another instructor or checkpilot acting as the "student." This was done for reasons of safety, allowing the instructor or checkpilot to build his skills in observing and recording without having to worry about the flight-safety capabilities of the "student" who was doing the flying. During this phase, the instructors who would be using only the simpler DPR received a total of ten hours inflight practice in administering the DPR, whereas the checkpilots received a total of 20 hours of inflight practice in the administration of the more complicated PPDR. Each of the practice DPRs and PPDRs was critiqued by the research staff. Errors and problems in the administration of the forms were discussed with the individuals concerned.

The final training activity consisted of actual use of the forms with student pilots on a routine basis. For this purpose the instructors utilized the DPR with a full class of students immediately preceding the first of the experimental classes.[6] Since the fixed wing primary flight training program was fairly lengthy, the instructors received considerable operational practice in the use of the DPR. The checkpilots also utilized the PPDR with real students during this period and thereby received ample operational experience with the PPDR.

This training activity served several purposes: (a) to train the instructors and checkpilots; (b) to provide data for final revisions of the PPDR and DPR; (c) to identify those flight personnel who could not or would not properly execute the data-gathering procedures; and (d) to give the research staff an idea of the form which the flight data would take.

Two other types of training activities were necessary for instructor and checkpilot personnel. The first consisted of training in the primary flight maneuvers in the leased aircraft. In spite of the fact that this aircraft was somewhat similar to the O-1, it was necessary to provide the instructors who would be teaching in the leased planes with a thorough check-out in the new aircraft. For this purpose each instructor and checkpilot received 15 hours of instruction and practice in the new aircraft prior to the initiation of the experiment proper. This practice included use of the PPDRs and DPRs for the leased planes. Beforehand, training personnel developed the exact standards of performance and procedures for the primary maneuvers to be followed in the leased aircraft and these were printed in a flight manual for use by students and instructors.

The last type of training was that of indoctrinating the instructors in the integrated approach to training. Fortunately, this step was made easier by the fact that the instructors selected to administer the integrated training had had previous experience with this type of training as Air Force instructors. The Air Force had adopted a type of integrated training which they labeled as "composite training" as a result of their own research on the subject (11). The indoctrination of the integrated instructors was accomplished by means of lecture and discussion, both group and individual.

In addition to the development of data forms and the instructor and checkpilot training for the primary phase of training, it was necessary to develop appropriate forms and train personnel in their use for the two advanced phases of training—Advanced Contact (Phase B) and Advanced Instruments (Phase C). A DPR form was developed for each of these stages of training. The form served for both daily grade (DPR) and checkride (PPDR) purposes. It was not possible to utilize a more elaborate PPDR form during these stages because the research staff was not large enough to conduct the necessary training and there was not a separate checkpilot department for these stages—checkrides being given by regular instructor personnel. Specimen pages from the DPRs used during the Advanced Contact and Advanced Instrument phases of training are shown in Appendices C and D, respectively. These DPRs were used both for daily performance recording by the instructor and for data gathering during the checkrides for the two phases of training.

In addition to the PPDR and DPR grades, the students were assigned daily and checkride grades reflecting the instructor's or checkpilot's overall evaluation of the flight. These grades, while subjective in nature, were based on the referents specified by the PPDR and DPR. A subjective grade of this type—that is, based on the PPDR—has been shown to be significantly more reliable than the regular subjective grade given without the use of the PPDR (8).

[6]At the time of this study classes started monthly. Since the primary training required four months there were four "flights" of instructors, with each flight receiving a new class every four months. Thus, there were three classes between this practice class and the first of the experimental classes.

The regular summary daily grade, assigned by the instructor utilizes a scale based on the student's experience level. The following categories were then in use by the Aviation School: AA, above average; A, average; BA, below average; U, unsatisfactory; D, dangerous.

In addition, the instructor was required to grade each day's performance of a maneuver as recorded in the DPR. In this case, however, instead of grading on the sliding level-of-experience scale, the instructor was asked to use an end-of-course standard. Thus, the typical student might well start out as "U" or "BA" and progress up to the "A" level only after a period of time.

For checkrides, a numerical grade was assigned—again based on the student's level of experience, using the following categories: 90-99, above average; 80-89, average; 70-79, below average; U, unsatisfactory; D, dangereous. No numerical grade was assigned for unsatisfactory or failing performance. For data treatment purposes, the AA, A, BA, and U or D are scored as 4, 3, 2, and 1, respectively. For checkrides, a value of 65 was assigned for a U or D performance.

Several other sources of data were available. One of the most obvious was rate of attrition among students during training. Another was the hour-level at which the students in the various training groups were able to solo the aircraft and take assigned checkrides. In addition, the comments of students and instructors were available as sources of information.

RESEARCH PROBLEM AND PROCEDURES

RESEARCH QUESTIONS

Work Unit INTACT was conceived as an operational tryout of the integrated training concept in Army primary fixed wing training. As such, it was not intended to test theoretical issues, but to try to establish parametric information on factors such as level of proficiency achieved and to identify operational problems encountered with integrated primary training in Army aviation. In essence, then, Work Unit INTACT involved the building and evaluation of an experimental primary flight training curriculum based on previous research efforts and on the various operational factors encountered in the Army's primary fixed wing training system.

The experimental design and data collection for this research were based on four questions concerning the effects of integrated training:

(1) What levels of flight proficiency in the performance of primary fixed wing flight maneuvers are achieved by students trained under integrated and under non-integrated primary flight training methods?

(2) Are there significant differences in attrition rates between integrated and non-integrated training methods?

(3) Will the time devoted to instrument training during the pre-solo and early contact stages of training (the first 35 hours) result, for the integrated student, in a significant increase in time to solo and a decrease in early contact proficiency?

(4) What levels of flight proficiency in the advanced instrument and advanced contact flight maneuvers are achieved by students trained under integrated and non-integrated primary flight training methods?

Work Unit INTACT was also designed to explore a fifth general question that had no direct relationship to questions concerning integrated training methods. This question was concerned with the relative advantages and disadvantages of side-by-side and tandem seating aircraft for primary fixed wing training. Comparisons generated by this question

involved students given the standard, non-integrated program of instruction in the leased side-by-side seating C-180 aircraft and another group who received the same program of instruction in the regular tandem-seating O-1 aircraft.

EXPERIMENTAL DESIGN

The general experimental design called for three groups of students,[7] each of which received a different combination of aircraft and program of primary instruction. The subjects were drawn from two FY 61 classes in Course No. 1-A-1980A, *Officer Fixed Wing Aviator Course (OFWAC)*. The classes were 61-6 and 61-10. Use of two such temporally separated classes made it possible for the same group of instructor personnel to teach both experimental classes, thus obviating the need to train a second group of instructors in the manner previously described. The use of two classes was necessary in order to allow a sufficient number of subjects in the three experimental groups.

The three experimental groups were defined as follows: The first group (henceforth referred to as I/SS) was to receive *integrated primary training in the leased side-by-side aircraft;* the second group (henceforth referred to as NI/SS) was to receive *non-integrated primary training in the side-by-side aircraft;* the third group (henceforth known as NI-T) was to receive *non-integrated primary training in the O-1 aircraft.* The only difference in treatment of the three experimental groups was in the type of *primary* training they received. During the Advanced Contact (Phase B) and Advanced Instrument (Phase C) training, the students all received the same instruction in the same aircraft. During the advanced training phases, the various experimental groups existed only in the records of the research team.

It was desired to have a student input of 18 students per class for each group—I/SS, NI/SS, and NI-T—giving a total input of 36 students into each of the three experimental groups. These students were selected in accord with the procedure outlined below; the students who were left over after this selection comprised a fourth group not involved in the research analysis. The input of 36 students into each of the three experimental groups was based on the desire to have groups of over 20 students available for each comparison and an assumed attrition of 25-35% for all three phases of training. Another factor that affected the size of each experimental group was the number of leased aircraft available (16) and the resulting number of students that could be supported by this fleet of primary training aircraft. The numbers of students and primary training conditions for each of the four groups of students are given in Table 1.

Table 1

Number of Students by Class and Primary Training Condition

	Experimental Group		
	I/SS	NI/SS	NI/T
Primary Training Method	Integrated	Non-integrated	Non-integrated
Primary Training Aircraft	Leased C-180 (Side-by-side)	Leased C-180 (Side-by-side)	O-1 (Tandem)
Number of Students			
Class 61-6	18	18	18
Class 61-10	18	18	18
Total	36	36	36

[7] A fourth group, made up of class students not selected for the experimental groups, also received training in the same classes as the three experimental groups, but their performance is not of interest in the research context.

SELECTION OF STUDENTS

In constituting the three experimental groups of principal concern to the goals of the study, the following selection criteria were applied: First, it was desired that all of the students in the three experimental groups have no previous flight training, or—if this were not possilbe—that they have a minimum of such experience. Second, it was desired that the three groups be essentially equal in aptitude for flying; to this end their scores on the Army Fixed Wing Aptitude Battery (AFWAB) were examined. Third, no field grade officers or foreign nationals were to be assigned to the groups.

The following procedure was used in assigning students to the three experimental groups: Immediately after the students reported to Fort Rucker they were assembled and required to fill out an information card. On the card they reported their previous flight instruction, if any. Their official records were screened to determine the aptitude (AFWAB)[8] scores (for those students whose records did not contain an official reporting of the AFWAB score, the AFWAB was administered in group session,[9] and the score was recorded on each student's information card. The cards were then separated into three gorupings: (a) company grade officers with no previous flight time; (b) company grade officers with 40 hours or less previous flight time; and (c) all others.

It had been hoped that the three experimental groups could be constituted from the students in the first grouping, but some of the students with previous flight time had to be used. In Class 61-6, three students (having 25, 17, and 12 hours of previous flight time, respectively) were assigned to I/SS, the integrated, leased aircraft group; four such students (with 30, 17, 6, and 3 hours, respectively) were assigned to NI/SS; four such students (with 37, 9, 6, and 3 hours, respectively) were also assigned to NI/T. In the second class, 61-10, it was necessary to assign only one previous flight time student to each of the three experimental groups. In this class the student assigned to I/SS had 35 hours, the one to NI/SS had 11 hours, and the one to NI/T had 36 hours.

After the potential candidates for the groups had been assembled, each student in the pool was assigned a code number. Actual placement of students in each of the three experimental groups was done on a random basis from these code numbers stratified by the three groupings described earlier.

The AFWAB scores of the three experimental groups thus assembled were then checked to see whether there was any significant imbalance among the three groups in flight aptitude as measured by the AFWAB. Analyses of variance performed on the AFWAB scores for each group for each class showed no significant difference among the groups, so the original random assignment of students was allowed to stand. Table 2 shows the means and ranges of AFWAB scores for the groups in each of the two experimental classes.

These procedures required about three days of the normal one-week in-processing period. It was necessary to make these assignments and notify the students as soon as possible because the training syllabus for the integrated training group (I/SS) called for the administration of six hours of synthetic trainer instruction prior to the first flight period. In order that the I/SS students not get behind the normal training schedule, the

[8] The AFWAB has been succeeded by the Flight Aptitude Selection Test (FAST) Battery in operational use.

[9] As a part of the application for flight training, applicants were required to take the AFWAB test. In view of the fact that about one-third of the students in Classes 61-6 and 61-10 had no officially recorded AFWAB score, although all said they had previously taken the test (some on more than one occasion), it was recommended that steps be taken to ensure that the score of anyone who takes the AFWAB (or ORWAB) be entered as part of his official record. It is understood that this administrative step has been taken.

synthetic training had to be accomplished during the in-processing period and the first day of flight instruction.

Table 2

Means and Ranges for AFWAB Scores by Experimental Group and Class

Group	Number of Students		Mean AFWAB		AFWAB Range	
	Class 61-6	Class 61-10	Class 61-6	Class 61-10	Class 61-6	Class 61-10
I/SS	18	18	59.8	58.8	30-103	19-97
NI/SS	18	18	56.7	59.9	22-93	25-100
NI/T	18	18	62.3	59.7	36-101	32-98

TRAINING

Students were assigned to primary instructors on the basis of three students per instructor. All three students assigned to an instructor were from the same experimental group. The I/SS group was administered training under the experimental integrated contact-instrument flight training syllabus. This experimental syllabus (shown in Appendix E) differed from the standard primary flight syllabus only in the manner in which the instrument and contact flight time were distributed throughout the primary flight program. Each syllabus provided 120 hours of total primary flight instruction, of which 32 hours were instrument and 88 hours contact instruction. In the integrated syllabus, the student received instrument instruction from the very beginning of and throughout the primary flight program. Under the standard syllabus, he received little or no instrument instruction prior to the 35-hour level, and had completed all or most of his 32 hours of instrument training by the 100-hour level.

As previously indicated, after completion of the Primary Phase of training, all students received the regular program of instruction during the two advanced training phases. At the time of the study, the Advanced Contact Phase was 80 hours in length and was administered in the O-1 aircraft. Phase C training, the Advanced Instrument Phase, was 50 hours in length and was administered in the U-6 Beaver Aircraft.[10] Thus, the total program was some 250[11] hours of flight instruction. At the end of this training, which required about 36 calendar weeks, the student became a rated Army aviator and was awarded a Standard Instrument Card. No changes were made in the academic training program for any of the three training phases during the course of this study.

DATA COLLECTION

As previously indicated, the PPDR and DPR instruments were the basic vehicles for collection of flight performance data. These instruments were used to record performance on the periodic checkrides administered student pilots, and daily performance was recorded on the DPR. The PPDR and DPR allowed determination of an "error" grade

[10] Advanced instrument training is now given in the twin-engine T-42 aircraft.

[11] The length and organization of the OFWAC course have been changed since this research was performed. The course currently totals 215 flight hours over 32 calendar weeks.

based on the various items on these two instruments. While several scoring techniques were used with the PPDR and DPR, the most usual was the number of errors or the percentage of errors. For purposes of exposition in this report, PPDR and DPR data will generally be expressed in terms of percentage of scored items on which errors were indicated.

Four checkrides were administered the students during the Primary Phase of training, two during the Advanced Contact Phase, and two during the Advanced Instrument Phase. The approximate hour-level at which these checkrides were scheduled to be administered and the general content of each are indicated in Table 3. This schedule of proficiency checks was that of the standard program and was not influenced by experimental considerations.

Table 3

Schedule and Content of Flight Checkrides

Title	Approximate Hour Level	Content
A-1	35 hours	Basic contact flight maneuvers
A-2	75 hours	Primary contact flight maneuvers
A-3	90 hours	Primary instrument maneuvers
A-4	110 hours	All primary contact flight maneuvers
B-1	160 hours	Advanced contact work (shortfield landings)
B-2	200 hours	Strip and road landings at tactical sites
C-1	225 hours	Basic attitude instrument flight
C-2	250 hours	Radio navigation & approaches; ATC procedures

For each of these checkrides, students were assigned both a numerical evaluation grade[12] and a percent error score. In addition, daily letter grades[12] and DPR error scores were available for the daily dual instructional flights. The other data of principal concern were the attrition rates and the actual hour-level at which the trainees were judged ready to take their checkrides.

RESULTS

Results will be presented separately for the three phases of training. More detailed data were gathered during the Primary Phase (the phase in which the experimental training was administered) than in the two advanced phases, so the results section gives more emphasis to the Primary Phase.

PRIMARY PHASE

Attrition

The attrition data for the Primary Phase of training are shown in Table 4, which sets forth the numbers of students in each group who began training, soloed, and took each of the four checkrides in Phase A, and the primary phase attrition percentage for each group. Neither the difference in attrition between the I/SS and NI/SS groups (which

[12] See page 9 for discussion of these grades.

compares integrated and non-integrated training methods while holding aircraft type constant), nor that between the NI/SS and NI/T groups (which compares side-by-side and tandem seating aircraft while holding type of training constant) was statistically significant, although the latter difference approached significance ($p<.10$). Thus, neither of the two principal experimental factors—type of training and type of aircraft—produced significant differences in flight attrition during Phase A.

Table 4
Number of Students Completing Each Stage of Primary Training

Experimental Group	Begin Primary	Stage					Primary Phase Attrition Rate
		Solo	A-1	A-2	A-3	A-4	
I/SS (Integrated leased aircraft)	36	31	30	27	27	27	25%
NI/SS (Non-integrated leased aircraft)	36	28	28	26	26	26	28%
NI/T (Non-integrated 0-1)	36	28	24	20	19	19	47%

Flight Time

The mean flight times required by each of the three experimental groups to reach five milestone progress points during their Primary Phase of training are shown in Table 5. These points are solo and the four scheduled checkrides. The mean time at each

Table 5
Mean Flight Time (Total, Contact, Instrument, and Solo) by Primary Training Stage (Hours)

Stage	Group	N	Total Time	Dual Contact	Dual Instrument	Solo
Solo	I/SS	31	17.0	12.6	4.4	–
	NI/SS	28	13.6	13.6	0.0	–
	NI/T	28	15.6	15.6	0.0	–
A-1	I/SS	30	38.2	24.2	7.6	6.4
	NI/SS	28	38.3	29.4	0.2	8.7
	NI/T	24	39.5	31.8	0.1	7.6
A-2	I/SS	27	76.0	39.3	13.6	23.0
	NI/SS	26	81.8	45.2	10.0	26.6
	NI/T	20	87.3	50.8	11.4	25.1
A-3	I/SS	27	91.5	44.3	18.7	28.4
	NI/SS	26	102.9	51.7	17.9	33.3
	NI/T	19	105.6	55.6	18.8	31.3
A-4	I/SS	27	104.5	49.6	21.4	33.4
	NI/SS	26	109.1	53.5	20.6	35.0
	NI/T	19	115.0	59.0	21.9	34.0

of these points is recorded in terms of total time, total dual contact instructional time, total dual instrument instructional time, and total solo time.

While no attempt is made to treat differences in flight time among the experimental groups in terms of statistical significance, there are several points worth noting. It will be recalled that the third research question stated in the section on experimental design concerned the effects of the early instrument training on the early contact proficiency of the integrated students. Inspection of Table 5 reveals that the I/SS students did require more total time to solo the aircraft (17 hours versus 13.6 hours) than did NI/SS. However, it should be noted that this time for I/SS students contained 4.4 hours of instrument instruction, and that the I/SS group actually soloed with less total *contact* instructional time than did NI/SS (12.6 hours versus 13.6 hours). The mean total time at the A-1 checkride level was virtually identical for I/SS and NI/SS. Thus, the I/SS group did not require more flight time before being judged ready for the A-1 checkride by their instructors. In fact, I/SS took their A-1 checkrides with an average of about 7 1/2 hours *less* contact time than did NI/SS.

Most of the other time differences shown in Table 5 can be described as administrative artifacts resulting from the different scheduling requirements for the various programs of instruction. However, the I/SS students do not suffer in these time comparisons.

Instructor Evaluation Grades

As previously stated, the flight instructor assigns the student a grade for each dual instructional flight, utilizing a four-point subjective scale. In view of the wide day-to-day fluctuations which can occur in such grades and the fact that the instructor frequently uses the daily grade as a means of motivating the student rather than reflecting his performance of that day, these data are not presented in this report. However,

Table 6

Instructor Evaluation Grades by Stage of Primary Training

Group	Stage											
	A-1			A-2			A-3			A-4		
	M	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*
I/SS	85.2	4.7	30	87.6	3.6	27	89.6	3.6	27	88.0	3.8	27
NI/SS	85.7	4.8	28	86.6	5.5	26	89.3	4.2	26	86.0	4.5	26
NI/T	81.5	6.2	24	82.6	4.8	20	87.4	2.9	19	81.9	5.0	19

Significance of Mean Differences[a]

	A-1	A-2	A-3	A-4
I/SS vs NI/SS	$t = 0.40$	$t = 0.78$	$t = 0.28$	$t = 1.73$
NI/SS vs NI/T	$t = 2.71^{**}$	$t = 2.62^{*}$	$t = 1.79$	$t = 2.82^{**}$

[a]* indicates a difference significant at the .05 level; ** difference significant at .01 level.

Appendix F presents daily grades (from the DPR)[13] for selected maneuvers to illustrate flight learning curves showing changes in daily performance over time. Also shown in Appendix F are the DPR objective performance data learning curves.

In addition, the instructor assigns an instructor evaluation (IE) grade, using a 70-99 numerical scale, to the student just prior to each checkride. The IE grade is, in effect, the instructor's estimate of the grade the student will receive on his checkride (CK).

In Table 6 the IE grades for the three experimental groups are shown for each of the four stages of primary training. In addition, the *t* ratios for the differences in mean IE grades between I/SS and NI/SS students and between NI/SS and NI/T students are shown. As can be seen, there were no significant differences between the I/SS and NI/SS groups, but NI/SS was evaluated significantly higher than NI/T by the instructors at all primary checkride levels except the A-3, or Final Instrument, level.

Checkride Grades

Two types of data are shown on performance on the four scheduled primary checkrides. The first is that dealing with the subjective checkride grade (CK) assigned by the checkpilot, utilizing the 70-99 scale, and the second is that resulting from use of the relatively objective PPDR.

Table 7 sets forth the results for the subjective checkride grades (CK), including the *t* tests for significance of differences between means for the I/SS and NI/SS groups and for the NI/SS and NI/T groups. The I/SS group was rated as significantly better than NI/SS on both the A-2 and A-4 checkrides. NI/SS was rated as significantly better than NI/T on the A-1 checkride.

The PPDR error data are shown in Table 8, including the *t* tests for I/SS versus NI/SS, and for NI/SS versus NI/T comparisons. The means are expressed both in terms of

Table 7

Checkride Grades by Stage of Primary Training

Group	Stage											
	A-1			A-2			A-3			A-4		
	M	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*
I/SS	83.1	7.6	30	87.1	4.0	27	89.6	3.5	27	86.4	3.9	27
NI/SS	82.1	8.0	28	84.2	5.3	26	87.8	5.5	26	82.7	6.1	26
NI/T	75.8	7.5	24	81.2	7.2	20	86.0	4.9	19	80.4	6.3	19

Significance of Mean Differences[a]

	A-1	A-2	A-3	A-4
I/SS vs NI/SS	$t = 0.46$	$t = 2.07$*	$t = 1.46$	$t = 2.71$**
NI/SS vs NI/T	$t = 2.92$**	$t = 1.56$	$t = 1.15$	$t = 1.25$

[a]* indicates a difference significant at the .05 level; ** difference significant at .01 level.

[13]See the discussion on pages 8 and 9.

number of errors made and percentage error. The differences in errors[14] between the I/SS and NI/SS groups were not significant at any of the four checkride levels, while the NI/SS group made significantly fewer errors than did NI/T on both the A-1 and A-4 checkrides.

Table 8

PPDR Errors by Stage of Primary Training

Group	Stage											
	A-1			A-2			A-3			A-4		
	M	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*
I/SS												
Errors	42.4	19.9	30	37.8	17.6	27	21.0	9.6	27	28.6	21.7	27
% Error	6.9	3.2		5.5	2.6		4.7	2.2		4.9	3.7	
NI/SS												
Errors	39.5	13.4	28	37.3	16.7	26	23.1	11.7	26	30.6	11.8	26
% Error	6.4	2.2		5.4	2.4		5.2	2.6		5.2	2.0	
NI/T												
Errors	52.3	16.4	24	36.4	17.0	20	27.[illegible]	15.6	19	37.7	13.3	19
% Error	9.4	2.9		5.8	2.7		6.2	3.5		7.3	2.6	

Significance of Mean Differences (% Error)[a]

	A-1	A-2	A-3	A-4
I/SS vs NI/SS	$t=0.70$	$t=0.15$	$t=0.75$	$t=0.37$
NI/SS vs NI/T	$t=4.12$**	$t=0.52$	$t=1.04$	$t=2.96$**

[a]* indicates a difference significant at the .05 level; ** difference significant at .01 level.

Miscellaneous

Several other types of observations and data were collected relating to student performance. Various questionnaires were administered to instructors and students, principally to gather background information [illegible] o operational problems in administering integrated instruction. This information is not reported here because it did not directly measure student performance and because of the relatively unsystematic nature of its collection. However, no major problems were encountered in the administration of integrated instruction.

[14]Significance of differences in errors was tested by comparing mean percent for the experimental groups on the various checkrides. Percent error was used rather than raw error due to the difference in number of PPDR items on the checkride forms for the leased and O-1 aircraft. For further discussion of this point see page 7 and Appendix A.

ADVANCED CONTACT PHASE

Attrition

As would be expected, most of the attrition from the program occurred during the Primary Phase. As was shown in Table 4, the Primary Phase was successfully completed by 27, 26, and 19 students of the 36 students each who started training in the three experimental groups. During the Advanced Contact Phase one student was lost from I/SS, two from NI/SS, and none from NI/T. Thus, Phase B was completed by 26, 24, and 19 students from I/SS, NI/SS and NI/T, respectively. There were no significant differences in attrition through Phase B between I/SS and NI/SS or between NI/SS and NI/T.

Flight Time

Data were not collected on flight time at the two checkrides scheduled in Phase B. However, it should be noted that both the I/SS and NI/SS groups, who received their primary training in the side-by-side aircraft, required five to ten hours of transition training in the O-1 aircraft as they began Phase B. The principal difficulty experienced by these students in going to the O-1 aircraft was directional control. For the first class, 61-6, this problem became apparent as the students entered Phase B, and the transition training was administered. With Class 61-10 the transition was administered at the end of Phase A.

Instructor Evaluation Grades

Because of the short span of Phase B, relatively few daily grades were given. The data from such grades are rather sketchy and therefore will not be presented here.

Checkride Grades

Phase B called for two scheduled checkrides, the B-1 and B-2 checks. In addition, prior to these two checkrides the students were administered an Advanced Progress Check

Table 9

Checkride Grades by Stage of Advanced Contact Training

Group	APC			B-1			B-2		
	M	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*
I/SS	76.8	[a]	27	81.6	5.2	27	81.8	6.2	26
NI/SS	77.4	[a]	26	81.7	5.5	25	81.0	6.9	24
NI/T	81.5	[a]	19	80.4	6.8	19	81.7	6.4	19

Significance of Mean Differences

	APC	B-1	B-2
I/SS vs NI/SS	not computed	$t = 0.07$	$t = 0.43$
NI/SS vs NI/T	not computed	$t = 0.68$	$t = 0.34$

[a]Not available.

(APC) immediately upon reporting for Phase B. This provided an initial assessment of student capabilities for the B Phase instructors. Table 9 presents the checkride grades for these three Phase B checkrides. The mean APC grades were provided by school records, but standard deviations were not provided, so it was not possible to test the statistical significance of group differences on this checkride. However, Table 9 does present the measures of variability and t ratios for the B-1 and B-2 checkrides.

As can be seen in Table 9 there was a substantial difference between NI/T and the other two groups on the APC. Had it been possible to test the statistical significance of this 4-plus point difference it probably would have been impressive, assuming grade variabilities similar to those on other checkrides. However, on both the B-1 and B-2 checkrides there were no significant differences. The APC differences reflected the transition problems previously mentioned. As the students from the I/SS and NI/SS groups entered Phase B, they were at a disadvantage compared with the NI/T students because they did not have the specific experience level in the O-1 aircraft possessed by the NI/T students.

A simplified PPDR was used to gather relatively objective data on the B-1 and B-2 checkrides; it was actually the same as the DPR form used in Phase B (see Appendix C). It did yield a percent error score similar to that derived from the Primary Phase PPDR. The B Phase PPDR data are shown in Table 10. None of the differences between I/SS and NI/SS or between NI/SS and NI-T was statistically significant.

Table 10

PPDR Percent Error by Stage of Advanced Contact Training

Group	B-1			B-2		
	M	*SD*	*N*	*M*	*SD*	*N*
I/SS	15.4	7.7	27	9.2	5.7	26
NI/SS	12.6	6.6	25	9.4	6.9	24
NI/T	15.5	9.2	19	10.3	6.3	19

Significance of Mean Differences

	B-1	B-2
I/SS vs NI/SS	$t = 1.41$	$t = 0.11$
NI/SS vs NI/T	$t = 1.16$	$t = 0.45$

Miscellaneous

The most significant miscellaneous observation, that having to do with transition to the O-1, has already been discussed. It was apparent with the first class that the Phase B instructors were not used to the teaching problems they encountered with the students

who had received their primary training in an aircraft other than the O-1. However, they quickly adjusted to the situation and handled the problems effectively.[15]

ADVANCED INSTRUMENT PHASE

Attrition

Very little additional attrition occurred during Phase C of the course. The only student who was eliminated in this phase was from the NI/SS group. Thus, at the end of Phase C, the final phase of training, 26 students (72%) in I/SS, 23 students (64%) in NI/SS, and 19 students (53%) in NI/T completed the entire OFWAC course successfully. Neither the difference between the I/SS and NI/SS groups, nor that between the NI/SS and NI/T groups was significant.

Flight Time

Since the nature of the course was such that each student was scheduled to receive a total of 250 flight hours during the three phases of training, there were no differences among the groups in flight time during Phase C.

Instructor Evaluation Grades

As in Phase B, few instructor daily grades were given and they are not reported.

Checkride Grades

There were two scheduled checkrides during Phase C, the C-1 and C-2 checks. The C-1 check covers the instruction given during the first half of Phase C on basic attitude instrument work, during which the student learned to control the U-6 Beaver aircraft solely by reference to the instruments. During the latter half of Phase C, which is covered by the C-2 checkride, the student learned radio navigation and approach procedures and the various procedures and communications he must execute in interacting with the FAA air traffic control system. As in preceding phases, both subjective numerical grades and the objective PPDR error scores were given.

Table 11 depicts the subjective checkride grades for the three groups on the two C Phase checkrides. There were no significant differences between groups for their checkride grades on either the C-1 or C-2 checks.

Table 12 shows the results from the C Phase PPDR. Again, none of the differences between groups is significant.

Miscellaneous

No unusual observations were noted during Phase C. Questionnaires relating to student self-confidence in their ability to safely execute an actual instrument flight did not reveal any differences of consequence among the three experimental groups.

[15]As mentioned in the Introduction of this report, the Army has recently acquired a fleet of T-41 training aircraft which are used for primary training. It might be expected that the directional control problems experienced by I/SS and NI/SS students of this study in transitioning to the O-1 would be compounded for students trained in the T-41. However, they handle the transition without undue difficulty.

Table 11

Checkride Grades by Stage of Advanced Instrument Training

Group	C-1			C-2		
	M	*SD*	*N*	*M*	*SD*	*N*
I/SS	81.7	4.5	26	81.3	5.7	26
NI/SS	82.3	6.0	23	83.6	5.3	23
NI/T	80.7	7.2	19	81.5	6.2	19

Significance of Mean Differences

	C-1	C-2
I/SS vs NI/SS	$t = 0.39$	$t = 1.46$
NI/SS vs NI/T	$t = 0.77$	$t = 1.17$

Table 12

PPDR Percent Error by Stage of Advanced Instrument Training

Group	C-1			C-2		
	M	*SD*	*N*	*M*	*SD*	*N*
I/SS	16.7	10.7	26	17.1	7.7	26
NI/SS	17.1	8.8	23	14.0	7.9	23
NI/T	18.7	11.1	19	16.0	8.8	19

Significance of Mean Differences

	C-1	C-2
I/SS vs NI/SS	$t = 0.14$	$t = 1.39$
NI/SS vs NI/T	$t = 0.51$	$t = 0.77$

DISCUSSION AND CONCLUSIONS

Before the results of this study are discussed, several comments are in order. First, this was an operational evaluation program. The training was administered and performance data were collected within an operational training system which is committed to the goal of producing graduates on a fixed schedule. The difficulties attendant to conducting research studies within ongoing military training programs are well known. It is hard to maintain control in the administration of the experimental treatments, and the operational requirements of the training system must take priority over research considerations. However, in spite of such problems, the instructor and checkpilot personnel in this study did an excellent job of carrying out their duties in accord with the guidance provided by the research staff. All in all, it is felt that this study represented as "clean" an experimental study of integrated training as could be done, at least on this scale, in an operational military aviation training setting.

Second, it should be noted that the relatively small numbers of subjects involved did not allow powerful tests of significance of differences. Therefore, some sizable differences which might be of considerable practical impact do not reach the required levels for statistical significance (e.g., the difference in flight attrition rates between NI/SS and and NI/T [28% vs. 47%] shown in Table 4).

Third, and a most important point to note, is that experimental variations during the two advanced stages of training were not allowed. All of the experimental variations were confined to the first, or primary, phase of training. Therefore, it was not possible to design an overall program of instruction covering the entire 250 hours of training best suited to the integrated training approach. For example, after receiving 120 hours of primary instruction in which the use of instrument cues was constantly stressed, the integrated student then entered the advanced contact phase in which any use of instrument cues was generally strongly contraindicated or forbidden by the instructor. Then, after being "weaned" away from his instruments in Phase B, the student went to the Advanced Instrument Phase in which the instruments were again emphasized. Thus, the overall instructional program could not conform to the existing Phase B and Phase C training structure and build on the instructional approach followed in Phase A for the I/SS students. Had it been possible to radically alter Phases B and C, a quite different outcome for the advanced training might have resulted.

The four research questions on the effects of integrated training, posed in the section on experimental design, provide the framework for discussion of results. With reference to the *first experimental question* having to do with the relative levels of primary phase proficiency of integrated and non-integrated students, the comparisons involving the I/SS and NI/SS groups are pertinent. There were no differences between these two training methods in instructor evaluation of the students or in the objective PPDR checkride error data. The only significant flight performance differences between I/SS and NI/SS during primary training were in the checkpilot-assigned subjective grades on the A-2 and A-4 checkrides; in both instances the integrated students were rated as significantly better than the non-integrated students. Thus, there was some performance evidence favoring the integrated training method during the Primary Phase, but the evidence was not overwhelming.

It will be noted that the differences in PPDR error scores for the A-2 and A-4 checkrides for the I/SS and NI/SS groups did not show statistical significance. However, in the case of the A-2 checkride the difference was essentially zero, and for the A-4 checkride it favored I/SS. Thus, the two sets of data are generally consonant.

While there is much in common between the number of errors made and the checkpilot's evaluation of the student's flight performance, these two measures are not perfectly correlated. Within the present study, correlations of .60 to .80 magnitude were

found between number of errors and checkride subjective grade. The checkpilot, understandably, is concerned about *what kinds* of errors were made and their *pattern*, as well as with the sheer number of errors. Also, environmental conditions (e.g., turbulence) will have a marked effect on number of errors made. It is reasonable to place some faith in the significant differences in checkride grades as being indicative of real differences in the primary flight capabilities of the two groups of students. Therefore, it is in order to draw the conclusion, with appropriate qualifications, that the integrated training method does possess some advantage over the non-integrated method within the 120-hour primary flight curriculum.

The above conclusion is consonant with the results of civilian studies (1, 4) which have reported advantages for the integrated training method. It should be noted that the civilian studies were conducted in the context of the private-pilot flight curriculum and involved 40-60 flight hours. Thus, the experience level of students in those studies was approximately that represented by the A-1 and A-2 checkride levels in the present study.

It is of some interest to note that, while one might logically have expected the integrated training method to show effects in the instrument flight performance of students, there was no significant difference in the performance of integrated and non-integrated students on the A-3, or instrument, checkride during primary training.

The second experimental question concerned relative attrition from the training program under integrated and non-integrated training methods. The results showed no significant difference between the two methods in attrition.

The third experimental question concerned the effects of the time devoted to instrument instruction under the integrated approach on early contact proficiency. The results indicate that there was no detrimental effect, other than the slightly longer total time to solo for the integrated group. In fact, even though their *total* time at the solo point was higher than the non-integrated students by about 3 1/3 hours, the integrated students actually soloed in about one hour less *contact* time. At the time of the A-1 checkride the integrated students were able to perform as well as the non-integrated students on this contact maneuver checkride, in spite of having some 7 1/2 hours less *contact* flight time.

In other words, the integrated students achieved the same level of contact maneuver flight performance on this checkride, but required only about 80% as much contact flight time to reach that level. Their 7 1/2 hours of instrument instruction at the A-1 checkride point can be looked upon as a sort of bonus, or by-product, area of proficiency resulting from integrated training. Thus, integrated training definitely does not handicap the student in terms of his early contact flight proficiency; rather, for the same investment in total flight time it produces equal contact proficiency plus some degree of instrument proficiency.

The fourth experimental question relating to integrated training, and the one of ultimate concern to a military training program, concerns the relative performance levels of the *graduate* pilot from integrated and non-integrated training programs. In the present study there was no significant difference in the flight performance of the two types of students in either the advanced contact or advanced instrument training phases. Thus, even though the integrated students possessed certain advantages in terms of their primary phase performance, this advantage had disappeared by the end of each of the two advanced training phases. The early differences washed out by the end of training.

In evaluating the above result, the comment at the beginning of this section concerning the possible effects of the inability to manipulate the two advanced training phases experimentally must be kept in mind. It is quite possible that an integrated 250-hour program might have produced a much more favorable long-term outcome for the integrated training method. However, further research would be necessary to establish this. All that can be said is there were no significant differences in favor of either

integrated or non-integrated training methods at the advanced training and end-of-course levels in the present study.

The implications of these results for operational training are rather complex. On the basis of these data alone it would not seem that adoption of integrated training would be warranted. Had the early advantage of the I/SS students been maintained, then implementation of integrated training might appear reasonable. Or, if the additional research mentioned, involving manipulations of the advanced training phases, had been done, implementation of integrated training might be indicated. However, it would appear likely that in an operational military training system of the magnitude of Army aviation training there will always remain a necessity for segregation of training (the "block" or "sandwich" training previously described) on the basis of required facilities, airspace, etc. Thus, achievement of a true integrated, long-term training program on a mass basis would appear fraught with very real operational difficulties which might outweigh possible proficiency advantages. This is not to say, however, that there are no changes in Army aviation training which can be made to build on the advantages of integrated training. Such possible program changes should be carefully evaluated before operational institution, but they are well worth considering.

A fifth general question concerned the effects of aircraft type and seating arrangement on student flight performance. Differences in performance throughout training were consistently in favor of NI/SS over NI-T; that is, the side-by-side seating leased aircraft students performed better than those trained in the tandem-seating O-1 aircraft. While results consistently favored NI/SS in these comparisons, less than half of the differences were sufficiently large to reach statistical significance. These results are quite provocative, however.

It should be borne in mind that the NI/SS versus NI-T comparisons cannot be viewed as a definitive side-by-side versus tandem comparison. There were a number of differences between the two aircraft, in addition to seating arrangement, which might well have affected student flight performance. There have been many informal logical analyses suggesting that side-by-side seating provides a much better instructing and learning environment. The data in the present study would seem to bear this out, but the above caution should be kept in mind in interpreting these results.

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AND
APPENDICES

LITERATURE CITED

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Appendix A

PRIMARY PHASE PILOT PERFORMANCE DESCRIPTION RECORD (PPDR)

Eight different PPDR forms were constructed for collecting objective primary phase flight performance data during INTACT I. Four of the forms were for use with the I/SS (integrated, side-by-side training) and NI/SS (non-integrated, side-by-side training) students, and the other four were for use with the NI-T (non-integrated, tandem training) students. The four forms for each type of aircraft (C-180 and O-1) corresponded to the four primary checkrides. Table A-1 shows the maneuvers covered by each of the eight PPDRs and the total number of errors possible on each PPDR.

The same maneuvers appeared on a given checkride for each of the two aircraft with the following exceptions: (a) The *Spin* maneuver appeared only on the A-1 and A-2 checkrides for the O-1 aircraft (spins were not permitted in the leased aircraft); and (b) five instrument maneuvers were included on the A-1 and A-2 checkrides for the leased aircraft PPDR but not on the O-1 forms. Only the I/SS students were checked on instrument maneuvers at the A-1 and A-2 checkride levels.

The variation in total possible errors between the leased aircraft and O-1 PPDRs for the A-1, A-2, and A-4 checkrides was due to the fact that the leased aircraft had a variable pitch propeller. As a consequence, power changes in that aircraft involved adjustment of both manifold pressure (throttle) and RPM (prop). In the O-1 only a change in RPM (throttle) was required. However, on the A-3 (instrument) checkride the number of items was identical for the two aircraft. This was due to the fact that the TO-1D was used for instrument training with NI/T students, and that aircraft also has a variable pitch propeller.

The PPDRs consisted of two basic types of items, scale and categorical. Scale items reflected those flight parameters which were continuous over a range of values. On each scale item a "proper" value or range of values was indicated. These proper values were based on standards established by the U.S. Army Aviation School.

On those scale items for which performance was to be recorded over a period of time (e.g., altitude during two minutes of straight and level flight), the proper value range was denoted by a solid triangle or ball covering that range. In the case of altitude, the triangle would indicate that variation within ± 50 feet from the reference altitude was allowable.

For certain scale items the value was recorded at some specific instant in time, rather than over a period of time. This was denoted by a small tear-drop shaped pip placed on the scale at the proper value—for example, number of degrees turned in a precision turn.

Examples of the various scale item types are shown in Table A-2. In recording performance on these scales, the checkpilot merely marked the appropriate portion(s) of the scale with a pencil. Recording was done in-flight as the maneuver was performed. In addition to the seven scales illustrated, there were a few items which required the checkpilot to write in the specific value of an item at some point in time. These were either to record airspeed in miles per hour, altitude in feet, or the elapsed time in

Table A-1

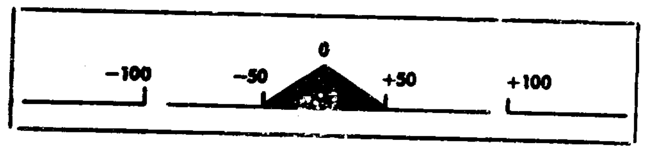
Maneuvers and Total Possible Errors for Primary PPDRs

Maneuvers	A-1		A-2		A-3		A-4	
	Leased C-180	O-1	Leased C-180	O-1	Leased C-180	O-1	Leased C-180	O-1
Contact								
Normal Take-off	✓	✓	✓	✓			✓	✓
Two 90° Climbing Turns	✓	✓	✓	✓			✓	✓
Straight and Level	✓	✓	✓	✓			✓	✓
90° Level Turns	✓	✓	✓	✓			✓	✓
Coordination Exercise	✓	✓						
360° Steep Turn (Right)	✓	✓						
Cruise Power Climbing Turn Stall	✓	✓						
Gliding Turns Stall (Power Recovery)	✓	✓						
Landing Attitude Stall	✓	✓						
Slow Flight	✓	✓	✓	✓				
Glides & Gliding Turns	✓	✓	✓	✓			✓	✓
Elementary Eights	✓	✓						
Rectangular Course	✓	✓	✓	✓			✓	✓
Entry to & Flying Traffic Pattern, and Normal Landing	✓	✓	✓	✓			✓	✓
Homing	✓	✓						
Forced Landing (500 Feet or Above)	✓	✓	✓	✓			✓	✓
Spins		✓		✓				
720° Steep Turn (Left)			✓	✓			✓	✓
Stalls - Advanced Series			✓	✓			✓	✓
Two Chandelles			✓	✓				
Lazy Eights			✓				✓	✓
Constant Airspeed/Bank Spiral			✓	✓			✓	✓
Spiral Around a Point - 360°			✓	✓				
Shallow Eights Around Pylons			✓	✓			✓	✓
Steep Eights Around Pylons							✓	✓
Instrument								
Instrument Take-off					✓	✓		
Climbing Turns - Two 90° Turns	✓		✓		✓	✓		
Straight Climb	✓		✓		✓	✓		
Level-off	✓		✓		✓	✓		
Timed Turns					✓	✓		
Compass Turns - Two 90° Turns					✓	✓		
Steep Turns	✓		✓		✓	✓		
Change Airspeed Straight & Level					✓	✓		
180° Turns					✓	✓		
Stall					✓	✓		
Unusual Attitude Recovery	✓		✓		✓	✓		
Change Airspeed in Level Turns					✓	✓		
Total Number of PPDR Errors Possible	617	556	685	623	443	443	584	516

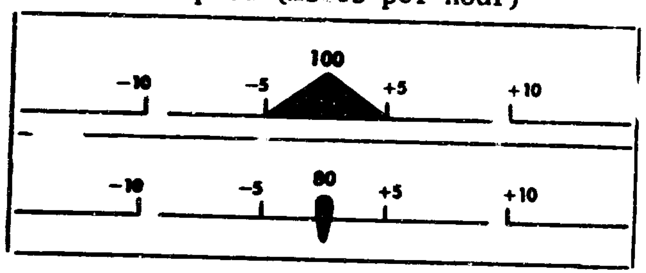
Table A-2

SCALE ITEMS

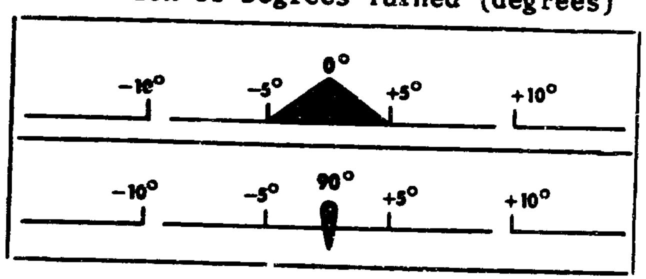
Altitude



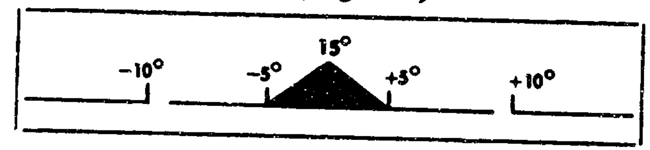
Airspeed (miles per hour)



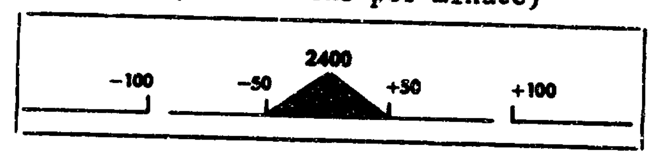
Direction or Degrees Turned (degrees)



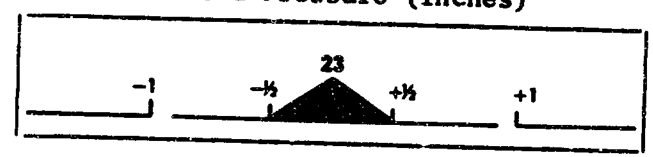
Bank (degrees)



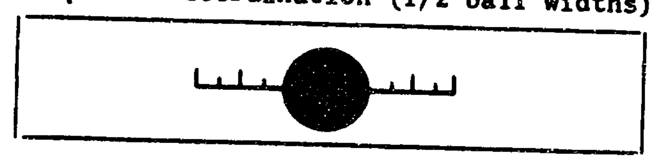
RPM (revolutions per minute)



Manifold Pressure (inches)



Torque and Coordination (1/2 ball widths)



seconds to reach some specified performance state such as time to reach straight and level condition in the instrument *Unusual Attitude Recovery* maneuver.

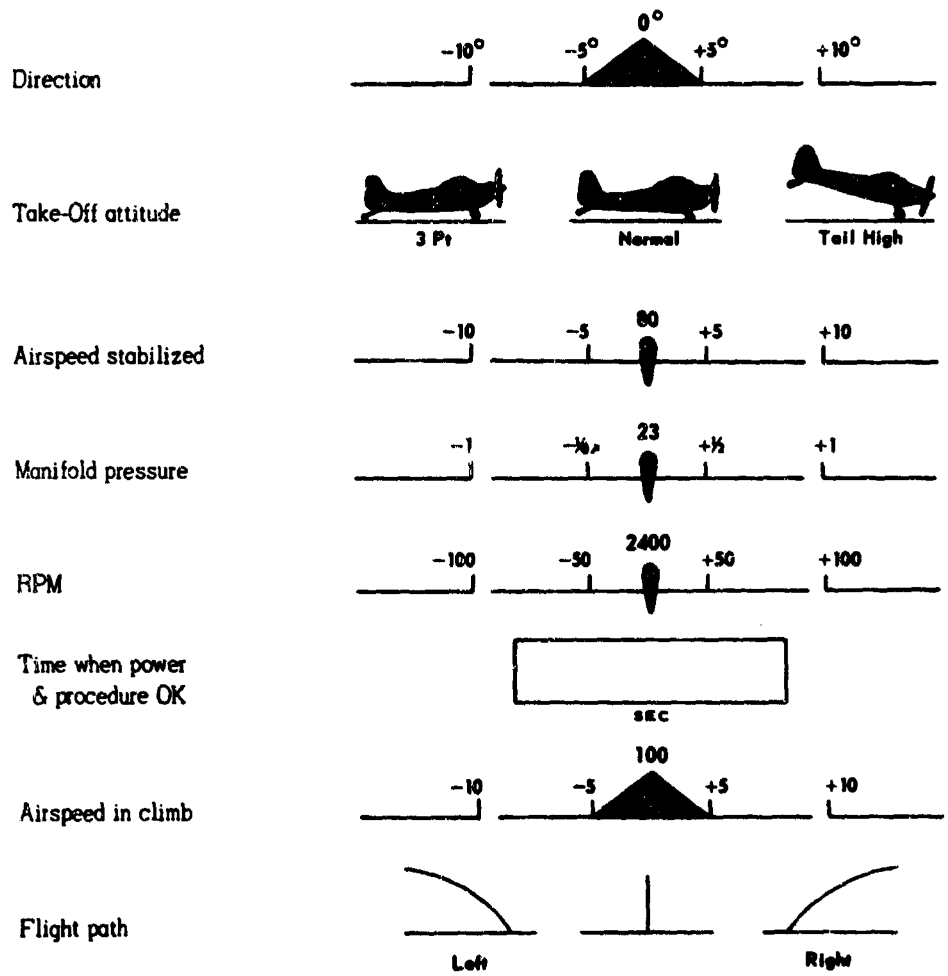
CATEGORICAL ITEMS

The categorical items required the assignment of a performance to one or two or more descriptive categories. An exhaustive listing of these items will not be attempted here. The specimen PPDR pages (Figures A-1 through A-10) illustrate a number of such items. The most frequent categorical item type was denoted by a single square box in which the checkpilot placed either a check (indicating correct performance) or an X (indicating incorrect performance). Some items involved category descriptors such as *early*, *proper*, or *late*, while others used pictorial representations. The specimen pages from the *Entry to & Flying Traffic Pattern, and Normal Landing* maneuver (Figure A-5) illustrate most of the categorical item types.

In addition to the scale and categorical items, the checkpilot was required to record a variety of other information on the PPDR form. These items provided identification data, weather information, and four category letter evaluation grades (see page 9) for each maneuver, for *Preflight Inspection* and for *Overall Judgment & Planning*.

NORMAL TAKE-OFF

NOTE TIME AT OPENING OF THROTTLE



Crosswind: None______; Light ______; Mod. ______; Severe ______

Figure A-1

STRAIGHT & LEVEL

MAINTAIN FOR 60 SECONDS (*Normal Cruise*)

Altitude — −100 | −50 | 0 | +50 | +100

Direction — −10° | −5° | 0° | +5° | +10°

Looks around ☐

Manifold pressure — −1 | −½ | 20 | +½ | +.

RPM — −100 | −50 | 2200 | +50 | +100

CHANGE AIRSPEED STRAIGHT & LEVEL (*Cruise to Slow Cruise*)

a. PREPARATION

RPM — −100 | −50 | 2400 | +50 | +100

Manifold pressure — −1 | −½ | 15 | +½ | +1

Altitude — −100 | −50 | 0 | +50 | +100

Direction — −10° | −5° | 0° | +5° | +10°

Torque & coordination

Trim ☐

Procedure correct ☐

Figure A-2 (continued)

STRAIGHT & LEVEL (*Continued*)

b. MAINTAIN FOR 60 SECONDS

Altitude	−100	−50	0	+50	+100
Direction	−10°	−5°	0°	+5°	+10°
Manifold pressure	−1	−½	15	+½	+1
RPM	−100	−50	2400	+50	+100

CHANGE AIRSPEED STRAIGHT & LEVEL *(Slow Cruise to Cruise)*

Manifold pressure	−1	−½	20	+½	+1
RPM	−100	−50	2200	+50	+100
Power sequence correct			☐		
Direction	−10°	−5°	0°	+5°	+10°
Altitude	−100	−50	0	+50	+100
Torque & coordination					
Trim			☐		

Turbulence: None ______; Light ______; Mod. ______; Severe ______.

Figure A-2

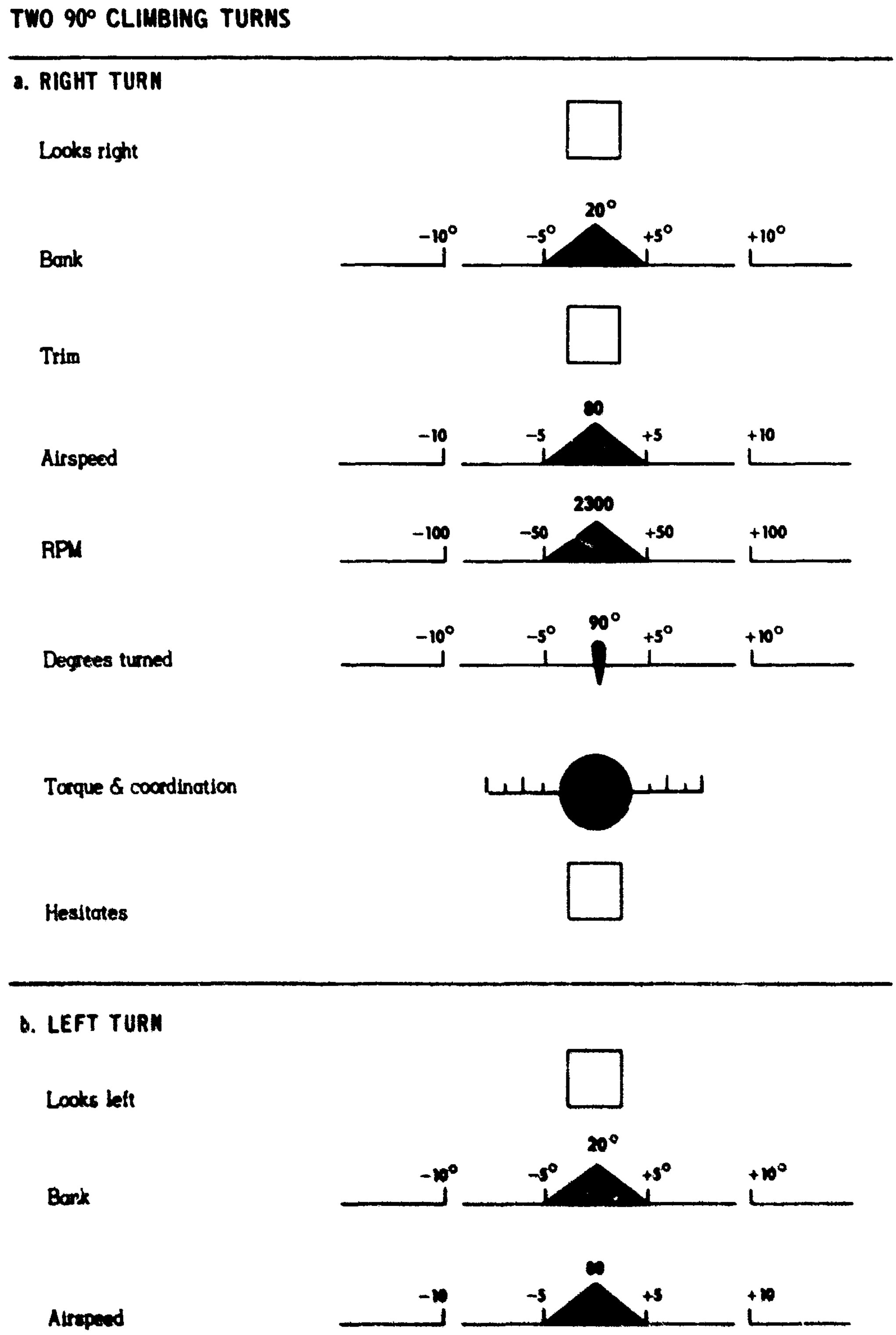
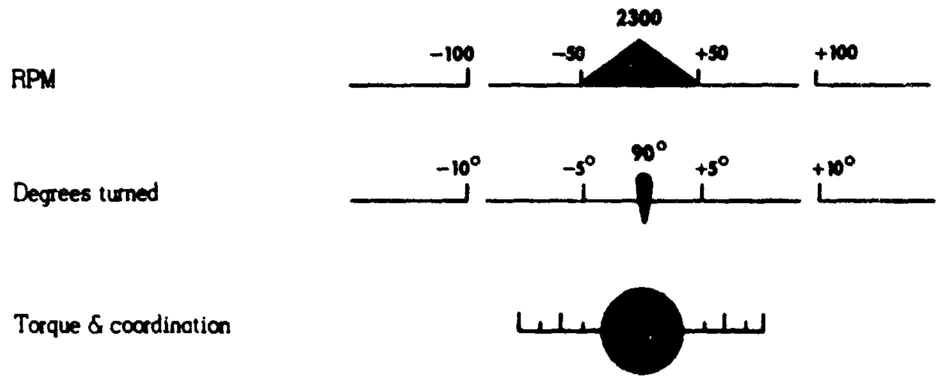


Figure A-3 (continued)

TWO 90° CLIMBING TURNS (Continued)



Turbulence: None ________; Light ________; Mod. ________; Severe ________.

Figure A-3

SPINS

a. PREPARATION

Clearing turns ☐

Starting altitude ______ FT

b. ENTRY

Pitch — Low / High

Leads with rudder ☐

Aileron neutral ☐

c. RECOVERY

Started proper place ☐

Rudder neutral when spin stops ☐

Maximum airspeed ______ MPH

No secondary stall ☐

Recovered straight ahead ☐

Altitude at recovery ______ FT

Turbulence: None ______; Light ______; Mod. ______; Severe ______.

Figure A-4

ENTRY TO & FLYING TRAFFIC PATTERN, AND NORMAL LANDING

a. ENTRY

Altitude	−100	−50	0	+50	+100
Entered at 45°			☐		
RPM	−100	−50	2400	+50	+100
Manifold pressure	−1	−½	15	+½	+1
Distance out OK			☐		
Entered correct place			☐		

b. DOWNWIND

Altitude	−100	−50	0	+50	+100
Ground track proper			☐		
Pre-landing cockpit check			☐		
Throttle retarded	Early				Late
Glide established			☐		
Airspeed	−10	−5	90	+5	+10
Flaps properly used			☐		
Airspeed	−10	−5	80	+5	+10

Figure A-5 (continued)

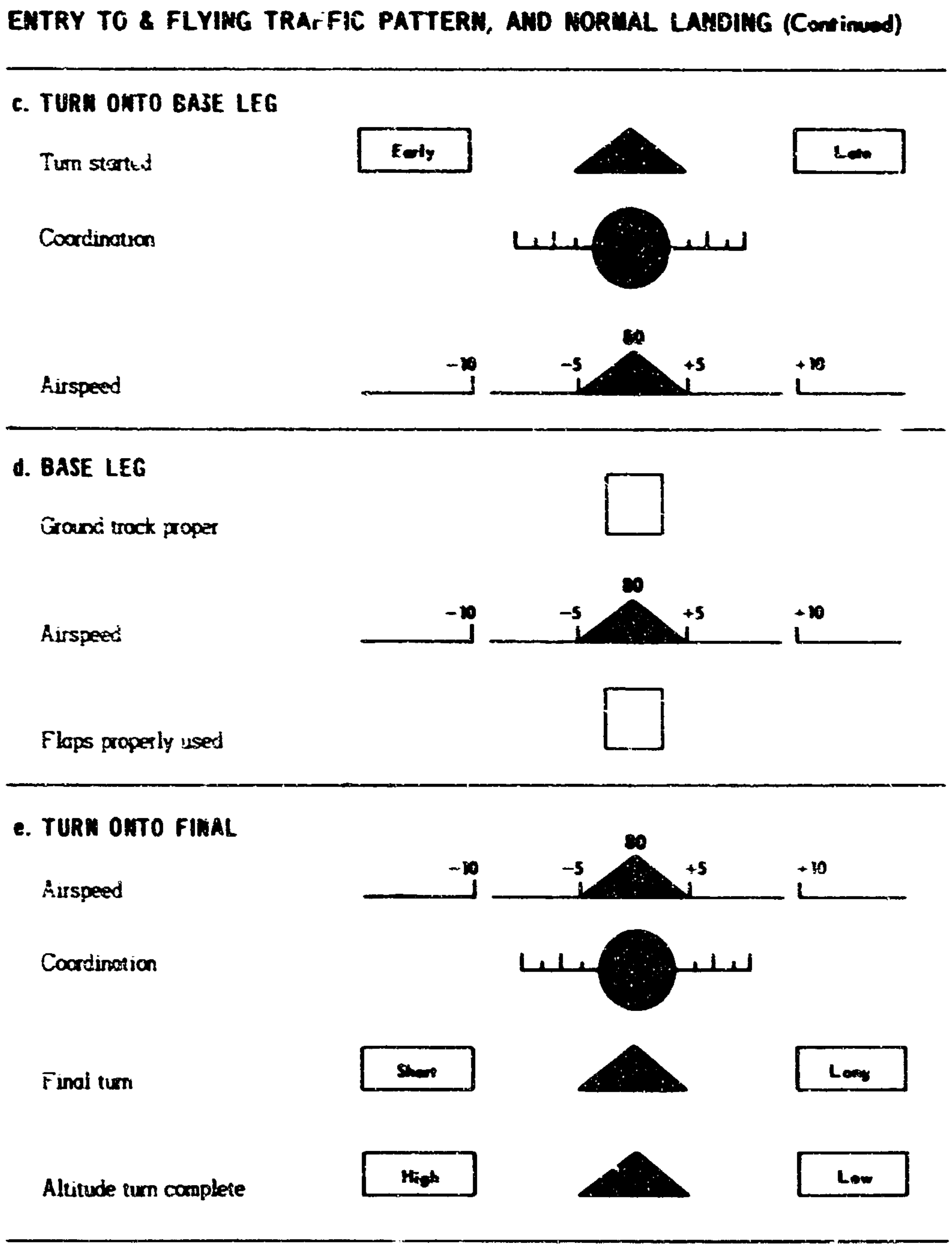


Figure A-5 (continued)

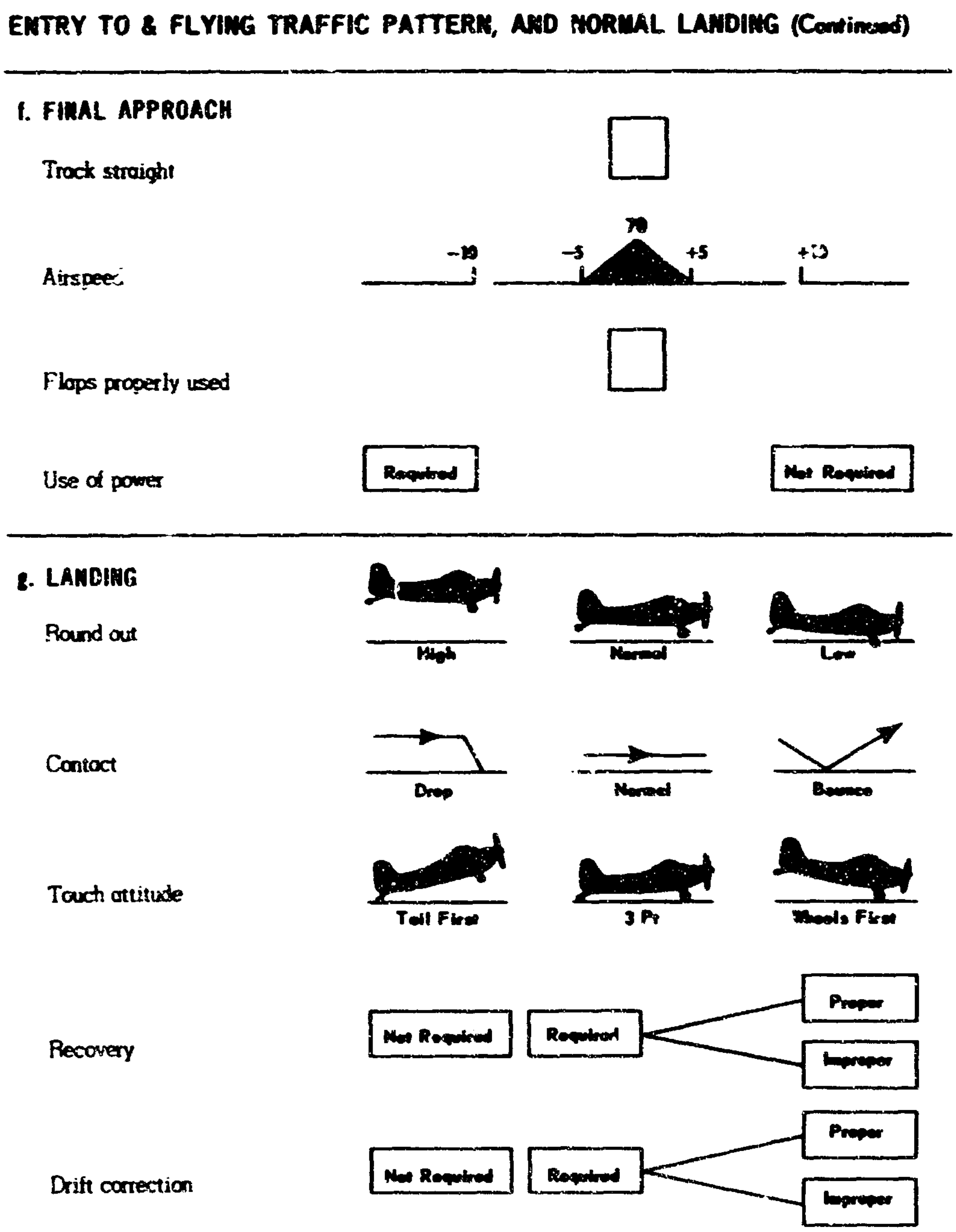


Figure A-5 (continued)

ENTRY TO & FLYING TRAFFIC PATTERN, AND NORMAL LANDING (Continued)

Point of contact	Short		Long
Directional control (on ground)			

Turbulence: None ________; Light ________; Mod. ________; Severe ________.

Crosswind: None ________; Light ________; Mod. ________; Severe ________.

Figure A-5

FORCED LANDING ***(1,000 Feet or Above)***

a. ENTRY

Glide established

Airspeed (15 seconds
or until flaps down)

Trim

Field choice

b. PATTERN

Maintained glide

INITIAL COCKPIT CHECK

Fuel valve & gauge

Carb. heat **ON**

Primer **CLOSED & LOCKED**

Cowl Flaps **CLOSED**

Ignition switch **ON**

Mixture **FULL RICH**

Figure A-6 (continued)

FORCED LANDING (Continued)

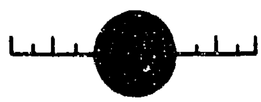
Attempt restart

Sequence proper

c. FINAL TURN

Airspeed

Coordination



Flaps properly used

FINAL COCKPIT CHECK

Fuel **OFF**

Mixture **FULL LEAN**

Switches **OFF**

Shoulder harness **TIGHT**

Made field

d. CLIMB-OUT

Climb attitude established

Flaps properly used

Figure A-6 (continued)

FORCED LANDING (Continued)

Airspeed

Climb-out in proper direction

Flaps 0°

Airspeed

Turbulence: None______; Light______; Mod.______; Severe______.

Figure A-6

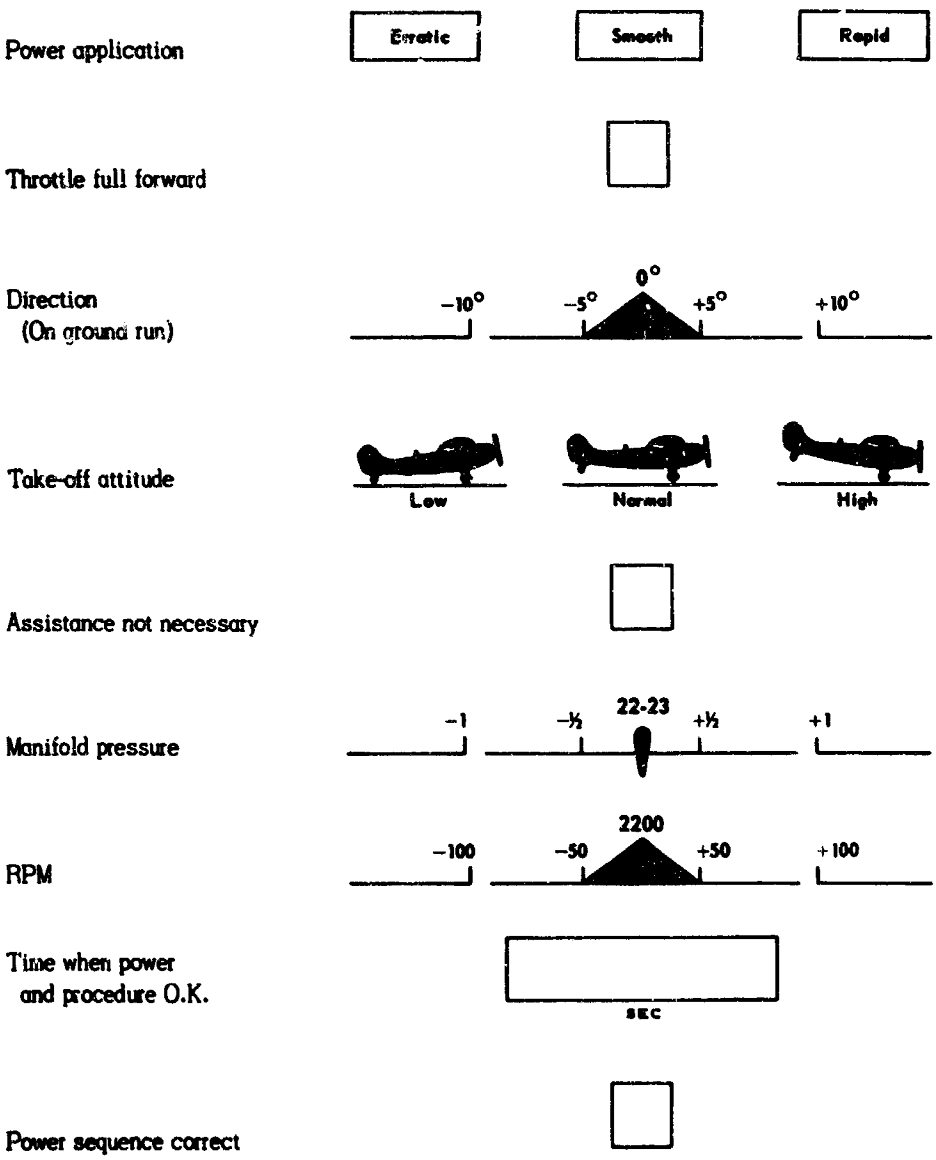


Figure A-7 (continued)

INSTRUMENT TAKE-OFF (Continued)

Direction (Scored from airborne to 500 ft.)

Trim

Crosswind: None________; Light ________; Mod. ________; Severe ________.

Figure A-7

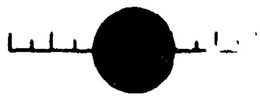
TIMED TURNS *(One 90° Right - One 180° Left)*

90° TURN RIGHT (CRUISE P/S)

a. ROLL-IN AND MAINTAINING

Bank

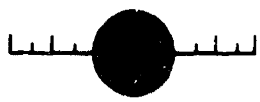
Torque & coordination



Altitude

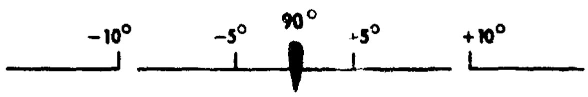
b. ROLL-OUT

Coordination



Altitude

Degrees turned



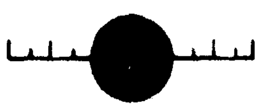
Seconds turned

180° TURN LEFT (CRUISE P/S)

a. ROLL-IN AND MAINTAINING

Bank

Torque & coordination



Altitude

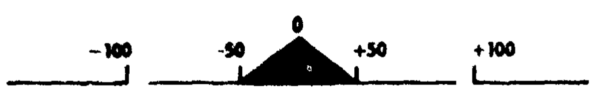
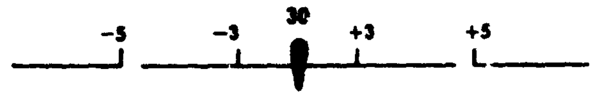


Figure A-8 (continued)

TIMED TURNS ***(One 90° Right - One 180° Left) (Continued)***

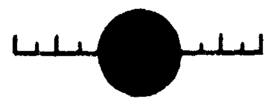
b. 90° POINT

Timing (Seconds)



c. ROLL-OUT

Coordination



Altitude

Degrees turned

Seconds turned

Turbulence: None ________; Light ________; Mod. ________; Severe ________.

Figure A-8

UNUSUAL ATTITUDE RECOVERY

a. STEEP CLIMBING TURN

START TIME WHEN STUDENT TAKES OVER

Correct throttle usage

Correct elevator usage

Correct aileron & rudder usage

Time to straight
and level attitude

SEC

SCORE FOR 30 SECONDS

Altitude

Direction

b. DIVING SPIRAL OPPOSITE DIRECTION

START TIME WHEN STUDENT TAKES OVER

Correct throttle usage

Correct elevator usage

Correct aileron & rudder usage

Figure A-9 (continued)

UNUSUAL ATTITUDE RECOVERY (Continued)

Proper sequence ☐

Time to straight
and level attitude ________ SEC

SCORE FOR 30 SECONDS

Altitude: −100 | −50 | 0 | +50 | +100

Direction: −10° | −5° | 0° | +5° | +10°

Turbulence: None ________; Light ________; Mod. ________; Severe ________.

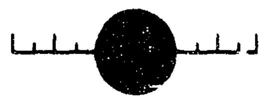
Figure A-9

CHANGING AIRSPEED IN LEVEL 180° TURNS *(100 MPH to Normal Cruise)*

a. TURN

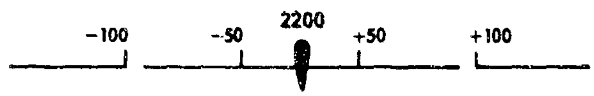
Bank

Torque & coordination



Manifold pressure

RPM



Proper power procedure ☐

Trims ☐

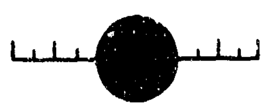
Altitude

b. RECOVERY (Straight & Level) (Check for 30 seconds)

Wings level (Bank)

Altitude

Torque & coordination



Turbulence: None ______; Light ______; Mod. ______; Severe ______.

Figure A-10

Appendix B

PRIMARY PHASE DAILY PROGRESS RECORD (DPR)

The DPR form was a simplified version of the PPDR, and its item content was virtually identical with the PPDR. However, there were no scale items in the DPR, all items being of the categorical, yes-no, or proper-improper type. Marking of the item consisted of a check or an X mark. Separate forms for the leased and O-1 aircraft were constructed.

The DPR was used by the instructor to record only the first performance of each maneuver on any dual instructional flight in which that maneuver was performed. For example, the student might perform ten take-offs during an instructional flight, but only his performance on the first one of those take-offs would be recorded. In addition to marking performance on the various flight items, the instructor would record the total number of errors made on that performance and would assign a four-category letter evaluation grade (see page 9) to that performance of the maneuver. Instead of relating the letter grade to the student's level of flight experience, the instructor was required to base the evaluation on an end-of-course level of experience.

The DPR booklet was 5 x 8 inches and contained enough spaces to record the student's daily progress for the entire primary course. Emphasis was placed on making the recording in-flight as the maneuver was performed.

Figures B-1 through B-11 illustrate specimen DPR pages for the same maneuvers shown in Appendix A. (Appendix F illustrates learning curves for four specimen maneuvers derived from DPR data.)

NORMAL TAKE-OFF

DATE												
Direction (±5°)												
Attitude												
Manifold Pressure 23 (±½)												
RPM 2400 (±50)												
Power Procedure correct												
A/S 100 (±5)												
Flight path (straight)												
ERRORS												
GRADE												

Figure B-1

STRAIGHT & LEVEL
(Two Minutes – Normal Cruise)

DATE												
Alt (±50)												
Direction (±5°)												
Looks around												
Manifold Pressure 20 (±½)												
ERRORS												
GRADE												

Figure B-2

90° CLIMBING TURNS

DATE												
	R	L	R	L	R	L	R	L	R	L	R	L
Looks												
Banks 20° (± 5°)												
Trim												
A/S 80 (±5)												
Max RPM 2300 (±50)												
Turns 90° (±5°)												
Coordination												
ERRORS												
GRADE												

Figure B-3

POWER-OFF SPINS

DATE												
ENTRY	R	L	R	L	R	L	R	L	R	L	R	L
Clearing turns												
Pitch												
Leads with rudder												
No aileron												
RECOVERY												
Starts at proper place												
Rudder neutral												
Max A/S 130												
No secondary stall												
Recovers straight ahead												
ERRORS												
GRADE												

Figure B-4

DATE												
ENTRY												
Alt 1000 (±50)												
Distance out												
DOWNWIND LEG												
Alt 1000 (±50)												
Ground track												
Cockpit check												
Throttle usage												
A/S 80-90 (±5)												
BASE LEG												
Timing of turn												
Coordination												
Ground track												
A/S 80 (±5)												
Flap usage												
FINAL TURN												
A/S 80 (±5)												
Coordination												
Timing of turn												
Alt												

Figure B-5 (continued)

FINAL APPROACH

Ground track												
A/S 70 (±5)												
Flap usage												
Power not required												

LANDING

Round out												
Touchdown proper												
Point of touchdown												
Ground control												
Recovery (if needed)												

ERRORS												
GRADE												

Figure B-5

FORCED LANDING

DATE												
Established glide												
Field choice												
Initial cockpit check												
Pattern adequate												
FINAL TURN & APPROACH												
A/S												
Coordination												
Flap usage												
Final cockpit check												
Made field												
CLIMB-OUT												
Establish climb												
Flap usage												
Safe route												
ERRORS												
GRADE												

Figure B-6

INSTRUMENT TAKE-OFF

DATE												
Smooth power application												
Full throttle												
Ground direction (±5°)												
Attitude												
No assist												
Manifold pressure 22-23 (±½)												
RPM 2200 (±50)												
Power sequence correct												
Direction to 500 (±5°)												
Proper trim												
ERRORS												
GRADE												

Figure B-7

180° TIMED TURNS

DATE												
ROLL-IN & MAINTAINING	R	L	R	L	R	L	R	L	R	L	R	L
Bank 15° (±5°)												
Torque & coordination												
Alt (±50)												
90° point 30 seconds (±3)												
ROLL-OUT												
Coordination												
Alt (±50)												
Degrees turned 180° (±5°)												
Seconds turned 60 seconds (±3)												
ERRORS												
GRADE												

Figure B-8

UNUSUAL ATTITUDE
(Diving Spiral)

DATE												
NOTE TIME AT START												
RECOVERY	R	L	R	L	R	L	R	L	R	L	R	L
Correct throttle usage												
Correct elevator usage												
Aileron/rudder usage												
Straight & level within 20 seconds												
MAINTAINING (30 seconds)												
Alt (±50)												
Direction (±5°)												
ERRORS												
GRADE												

Figure B-9

UNUSUAL ATTITUDE
(Steep Climbing Turn)

DATE												
NOTE TIME AT START												
RECOVERY	R	L	R	L	R	L	R	L	R	L	R	L
Correct throttle usage												
Correct elevator usage												
Aileron/rudder usage												
Straight & level within 20 seconds												
MAINTAINING (30 seconds)												
Alt (±50)												
Direction (±5°)												
ERRORS												
GRADE												

Figure B-10

CHANGING A/S LEVEL 180° TURNS
(100 MPH to Cruise)

DATE												
TURNS	R	L	R	L	R	L	R	L	R	L	R	L
Bank 15° (±5°)												
Coordination												
Manifold pressure 20 (±½)												
RPM 2200 (±50)												
Power sequence correct												
Proper time												
Alt (±50)												
RECOVERY TO STRAIGHT & LEVEL (for 30 seconds)												
Wings level 0° (±5°)												
Alt (±50)												
ERRORS												
GRADE												

Figure B-11

Appendix C

ADVANCED CONTACT PHASE DAILY PROGRESS RECORD (DPR)

The DPR form for the Advanced Contact Phase of training was constructed in the same manner as the Primary DPR. Only one form was necessary, since all students received their Phase B training in the O-1 aircraft. The only difference in its manner of employment was that it served as both the DPR and PPDR for Phase B. The same form was used to record both daily performance and checkride performance. Also, as can be seen in Figures C-1 and C-2, the Phase B DPR called for three recordings per day on the *Stagefield* and *Strip Landing* maneuvers. The instructor recorded the first and last performances of the period and also one near the mid-point of the period.

Since there were only six maneuvers covered in Phase B training, all six DPR forms are shown in Figures C-1 through C-6.

STAGEFIELD

DATE												
DOWNWIND	1	2	3	1	2	3	1	2	3	1	2	3
Dis. out												
Altitude												
Pre-landing check												
Track												
Flaps												
Power control												
BASE LEG												
Turn proper												
Track												
Attitude												
Flaps												
Power control												
FINAL												
Turn proper												
Line of descent												
Power control												
Attitude												
Track												
Carb. heat OFF												
OVER BARRIER												
Attitude												
Altitude												
Power control												
Track												
X-wind tech.												

STAGEFIELD

Figure C-1 (continued)

ROUND-OUT												
Attitude												
Power control												
Track												
TOUCHDOWN AND LANDING ROLL												
Attitude												
Power control												
Stick control												
Touchdown area												
Use of brakes												
Directional control												
GO-AROUND												
Timeliness of decision												
Power control												
Attitude												
Flaps												
Track												
Alertness												

ERRORS												
GRADE												

ERRORS				
GRADE				

Figure C-1

DATE												
ORIENTATION	1	2	3	1	2	3	1	2	3	1	2	3
Strip no.												
Located strip												
Strip difficulty												
HIGH RECON.												
Dis. out												
Altitude												
Time												
Info.												
Planning												
LOW RECON.												
Started corr.												
Altitude												
Cockpit check												
Attitude												
Power control												
Flight path												
Flaps												
Info.												
CLIMB-OUT												
Established climb												
Safe route												

Figure C-2 (continued)

APPROACH PATTERN

Cockpit check												
Altitude												
Attitude												
Flaps												
Planning												

FINAL APPROACH

Turn proper												
Carb. heat OFF												
Line of descent												
Attitude												
Power control												
Track												

OVER BARRIER

Attitude												
Altitude												
Power control												
Track												
X-wind tech.												

ROUND-OUT

Altitude												
Power control												
Track												

Figure C-2 (continued)

TOUCHDOWN AND LANDING ROLL												
Attitude												
Power control												
Stick control												
Touchdown area												
Use of brakes												
Directional control												

GO-AROUND												
Timeliness of decision												
Power control												
Attitude												
Flaps												
Track												
Safe route												

Alertness												

ERRORS												
GRADE												

ERRORS				
GRADE				

Figure C-2

DATE												
ORIENTATION												
Strip no.												
Located strip												
Strip difficulty												
HIGH RECON.												
Dis. out												
Altitude												
Time												
Info.												
Planning												
LOW RECON.												
Started corr.												
Altitude												
Cockpit check												
Attitude												
Power control												
Flight path												
Flaps												
Info.												
CLIMB-OUT												
Established climb												
Safe route												

Figure C-3 (continued)

APPROACH PATTERN

Cockpit check												
Altitude												
Attitude												
Flaps												
Planning												

FINAL APPROACH

Turn proper												
Carb. heat OFF												
Line of descent												
Attitude												
Power control												
Track												

OVER BARRIER

Attitude												
Altitude												
Power control												
Track												
X-wind tech.												

ROUND-OUT

Altitude												
Power control												
Track												

Figure C-3 (continued)

TOUCHDOWN AND LANDING ROLL												
Attitude												
Power control												
Stick control												
Touchdown area												
Use of brakes												
Directional control												
GO-AROUND												
Timeliness of decision												
Power control												
Attitude												
Flaps												
Track												
Safe route												
Alertness												
ERRORS												
GRADE												

Figure C-3

DATE												
LINE-UP												
Cockpit check												
Direction												
Clears												
Brake usage												
Stick control												
Power control												
TAKE-OFF ROLL												
Directional control												
Stick control												
X-wind tech.												
TAKE-OFF												
Attitude												
Track												
Airspeed												
X-wind tech.												
OVER BARRIER												
Attitude												
Airspeed												
Track												

Figure C-4 (continued)

MAXIMUM PERFORMANCE TAKE-OFF

CLIMB-OUT

Attitude												
Track												
Power control												
Airspeed												
Flaps												
Safe route												

Alertness												

ERRORS												
GRADE												

Figure C-4

DATE												
INITIAL ACTION												
Established glide												
Field choice												
Initial cockpit check												
Pattern adequate												
FINAL TURN AND APPROACH												
Airspeed												
Coordination												
Flap usage												
Final cockpit check												
X-wind tech												
Made field												
CLIMB-OUT												
Established climb												
Flap usage												
Safe route												
ERRORS												
GRADE												

Figure C-5

DATE												
INITIAL ACTION												
Established glide												
Pattern correct												
Flap usage												
Final cockpit check												
X-wind tech.												
Made field												
CLIMB-OUT												
Established climb												
Flap usage												
Safe route												
ERRORS												
GRADE												

Figure C-6

Appendix D

ADVANCED INSTRUMENT PHASE DAILY PROGRESS RECORD (DPR)

The remarks in Appendix C are pertinent to the Phase C DPR construction and use also. The same form was used for both daily and checkride recording. Only a single form, for the U-6 aircraft, was constructed, since all students received their advanced instrument training in that aircraft.

Thirteen different instrument maneuvers or missions were covered. These are shown in Figures D-1 through D-13.

INSTRUMENT TAKE-OFF

DATE												
Smooth Power Application												
Take-off Power (35-37)												
Ground Direction (±5°)												
Attitude												
No Assist												
RPM 2000 (±50)												
Manifold Pressure (30-32)												
Power Sequence Correct												
Direction to 500 (±5°)												
ERRORS												
GRADE												

Figure D-1

DATE												
Figured Time Correct												
ROLL-IN & MAINTAINING	R	L	R	L	R	L	R	L	R	L	R	L
Rate of Roll-in												
Bank 15° (±5°)												
Rate of Turn (±½ Needle)												
Coordination												
Altitude (±50)												
ROLL-OUT												
Rate of Roll-out												
Coordination												
Altitude (±50)												
Time (±3 Seconds)												
Degrees Turned (±5°)												
ERRORS												
GRADE												

Figure D-2

COMPASS TURNS

DATE												
TURN TO	N	E	S	W	N	E	S	W	N	E	S	W
ROLL-IN & MAINTAINING												
Rate of Turn (± ½ Needle)												
Coordination												
Altitude (± 50)												
ROLL-OUT												
Coordination												
Altitude (± 50)												
Degrees Turned (± 5°)												
ERRORS												
GRADE												

ERRORS						
GRADE						

Figure D-3

DATE												
ROLL-IN & MAINTAINING	R	L	R	L	R	L	R	L	R	L	R	L
Rate of Roll-in												
Coordination												
Altitude (±50)												
Rate of Turn												
ROLL-OUT												
Rate of Roll-out												
Coordination												
Altitude (±50)												
ERRORS												
GRADE												

Figure D-4

180° CLIMBING TURNS

DATE												
ENTRY	R	L	R	L	R	L	R	L	R	L	R	L
Manifold Pressure 30-32 (± 1)												
Pitch, Bank & Power Control												
MAINTAINING												
A/S 100 (± 5)												
Bank 15° (± 5°)												
Vertical Speed 500 (± 100)												
Pitch & Power Control												
RECOVERY (100 MPH)												
Pitch, Bank & Power Control												
Degrees Turned 180° (± 5°)												
Altitude 500 (± 50)												
Manifold Pressure 20-24 (± 1)												

ERRORS												
GRADE												

ERRORS						
GRADE						

Figure D-5

180° DESCENDING TURNS

DATE						

	R	L	R	L	R	L	R	L	R	L	R	L
ENTRY												
Manifold Pressure 15-17 (±1)												
Pitch, Bank & Power Control												
MAINTAINING												
A/S 100 (±5)												
Bank 15° (±5°)												
Vertical Speed 500 (±100)												
Pitch & Power Control												
RECOVERY (100 MPH)												
Pitch, Bank & Power Control												
Degrees Turned 180° (±5°)												
Altitude 500 (±50)												
Manifold Pressure 20-24 (±1)												

ERRORS												
GRADE												

ERRORS						
GRADE						

Figure D-6

UNUSUAL ATTITUDE (Steep climbing turn)

DATE						

NOTE TIME AT START

	1	2	1	2	1	2	1	2	1	2	1	2
RECOVERY												
Correct throttle usage												
Correct elevator usage												
Aileron/rudder usage												
Straight & level within 20 seconds												
MAINTAINING (30 seconds)												
Altitude (± 50)												
Direction (± 5°)												
ERRORS												
GRADE												

ERRORS						
GRADE						

Figure D-7

UNUSUAL ATTITUDE (Diving Spiral)

DATE						

NOTE TIME AT START

RECOVERY	1	2	1	2	1	2	1	2	1	2	1	2
Correct throttle usage												
Correct aileron/rudder usage												
Correct elevator usage												
Straight & level within 20 seconds												
MAINTAINING												
Altitude (±50)												
Direction (±5°)												

ERRORS												
GRADE												

ERRORS						
GRADE						

Figure D-8

DATE

ORIENTATION

Tune Radio

Procedure

Altitude (± 50)

TRACK INTERCEPTION

Turn to Intended Heading (± 5°)

Rolled Out on Course

Altitude (± 50)

TRACKING INBOUND

Track (± 2°)

Altitude (± 50)

STATION PASSAGE

Turn

Power

Report

Altitude (± 50)

HOLDING

Entry

Heading (± 5°)

Tracking (± 2°)

Timing

Altitude (± 50)

PROCEDURE TURN

Track (± 2°) (if applicable)

Procedure Turn

Altitude (± 50)

APPROACH

Rolled Out on Course

Track (± 2°)

Low Station Altitude (± 50)

Minimum Altitude (± 50)

Airspeed

MISSED APPROACH

Time

Report

Prescribed Procedures

ERRORS

GRADE

ERRORS

GRADE

Figure D-9

DATE

ORIENTATION

Tune Radio

Procedure

Altitude (± 50)

TRACK INTERCEPTION

Turn to Intended Heading (± 5°)

Rolled Out on Course

Altitude (± 50)

TRACKING INBOUND

Track (± 5°)

Altitude (± 50)

STATION PASSAGE

Turn

Power

Report

Altitude (± 50)

HOLDING

Entry

Heading (± 5°)

Tracking (± 5°)

Timing

Altitude (± 50)

PROCEDURE TURN

Track (±5°) (if applicable)

Procedure Turn

Altitude (± 50)

APPROACH

Rolled Out on Course

Track (± 5°)

Low Station Altitude (± 50)

Minimum Altitude (± 50)

Airspeed

MISSED APPROACH

Time

Report

Prescribed Procedures

ERRORS

GRADE

ERRORS

GRADE

Figure D-10

DATE												
INITIAL CALL												
Position Report												
FIELD DEPARTURE												
Report												
Heading Control												
Altitude												
DOWNWIND												
Turn Proper												
Heading Control												
Altitude												
Initial Cockpit Check												
BASE LEG												
Turn Proper												
Heading Control												
Altitude												
Final Cockpit Check												
FINAL												
Turn Proper												
Heading Control												
Altitude Control												
Airspeed												
ERRORS												
GRADE												

Figure D-11

DATE

TRANSITION

Tune Radio

Track (VOR ± 2°) (ADF ±5°)

Altitude

OUTER MARKER OR FIX

Turn

Power

Report

Altitude (± 50)

HOLDING

Entry

Heading

Track (± ½°)

Timing

Altitude

PROCEDURE TURN

Track (± ½°)
(if applicable)

Procedure Turn

Altitude (± 50)

APPROACH

Rolled Out on Course

Track (± ½°)

Low Station Altitude
(± 50)

Minimum Altitude (± 50)

Airspeed

Altitude Control

MISSED APPROACH

Time

Report

Prescribed Procedures

ERRORS

GRADE

ERRORS

GRADE

Figure D-12

DATE		

DEPARTURE

Heading or Track		
Climb		
Radio Procedure		
Reports		

ENROUTE

	1st ½	2nd ½	1st ½	2nd ½
Track (VOR 2°) (ADF 5°)				
Altitude (± 100)				
Radio Tuning				
Reporting				
ETA's (± 3)				
Course Changes (10° +)				
Altitude Changes				

TERMINAL

Heading or Track		
Altitude (± 50)		
Radio Tuning		
Reports		

STATION PASSAGE

Turn		
Power		
Report		
Altitude (± 50)		

HOLDING

Entry		
Heading		
Tracking (VOR ± 2°) (ADF ± 5°) (ILS ± ½°)		
Timing		
Altitude (± 50)		

PROCEDURE TURN

Tracking		
Procedure Turn		
Altitude (± 50)		

FINAL APPROACH

Rolled Out on Course		
Tracking (VOR ± 2°) (ADF ± 5°) (ILS ± ½°)		
Low Station Altitude (± 50)		
Minimum Altitude (± 50)		
Airspeed		
Altitude Control		

MISSED APPROACH

Time		
Report		
Prescribed Procedures		

Type Approach		

ERRORS		
GRADE		

Figure D-13

Appendix E

EXPERIMENTAL FLIGHT SYLLABUS: INTEGRATED CONTACT-INSTRUMENT PRIMARY FLIGHT TRAINING

Training Day	Period	Maneuver	Flight Time				
			Hood	Dual	Solo	Period	Cum. Total
1		Inprocessing					
2		Briefing and Link (1:40)					
3		Link (1:40) and pre-flight briefing a. Basic aircraft (component parts) b. Visual inspection c. Effect and use of controls d. Instruments e. Sta[illegible]ng procedures f. Run-up procedures g. Shut-down procedures h. Emergency procedures					
4	IF-1 CP-1	Link (1:40) and Flight (1) a. Taxiing b. Torque effect on take-off c. Pitch control (straight & level) d. Bank control (level turns) (standard rate) (2) Student follows through on take-off while under hood and takes over at safe altitude. Practices straight & level and level turns. Maneuvers should be practiced first on instruments, then contact. Instructor points out and relates the two ways of determining aircraft attitude: (a) by reference to instruments; and (b) by reference to the horizon.	00:30	00:15		00:45	00:45
5	IF-2 CP-2	(1) Review previous period (2) Demonstrate and practice a. ITO (contact and instruments) b. At safe altitude student goes under hood and practices: climbs, descents, straight and level, turns, power changes (straight & level and turns) and trim. Student should practice each new maneuver under the hood, then contact (Standard rate turns). c. Coordination exercise (demonstration only)	00:30	00:30		1:00	01:45
6	IF-3 CP-3	(1) Review previous periods (2) Demonstrate and practice a. Student makes ITO, climbs to altitude and reviews previous maneuver. b. Steep turns (up to 45° bank under hood, and 60°bank contact). Emphasize the relationship between contact cues and attitude indicator.	00:30	00:30		1:00	02:45

Continued

Appendix E *(Continued)*

Training Day	Period	Maneuver	Flight Time Hood	Dual	Solo	Period	Cum. Total
7	IF-4 CP-4	(1) Review previous periods (2) Demonstrate and practice a. ITO b. Use of vertical speed for climbs and descents at a definite rate. c. Turns to predetermined headings (point out relationship between DG and magnetic compass).	00:30	00:30		01:00	03:45
8	IF-5 CP-5	Review all previous periods	00:30	00:30		01:00	04:45
9	IF-6	Demonstrate and practice a. ITO b. Climbs and descents to predetermined altitudes c. Steep turns d. Clearing turns (contact) e. Slow flight (minimum airspeed)	00:30	00:30		01:00	05:45
10	IF-7 CP-7	(1) Demonstrate and practice a. Take-off (contact) b. Climbs and climbing turns (hood) Descents and descending turns (hood) c. Glides and gliding turns (contact) d. Level turns (hood) e. 90° side approach f. Landings (2) Demonstrate only Confidence maneuvers (3) Review and practice Steep turns	00:15	00:45		01:00	06:45
11	IF-8 CP-8	(1) Practice basic instrument maneuvers for improving proficiency (2) Review previous contact work (3) Demonstrate and practice a. Go-around procedures (minimum of five) b. Control timing exercise c. "S" turns d. 180° side approach	00:15	00:45		01:00	07:45
12	IF-9 CP-9	(1) Review previous contact work (2) Demonstrate and practice a. Landing attitude stalls b. Power-off gliding turn stalls (recovery without power) c. Cruise power climbing turn stalls (hood and contact) d. Track control exercise e. Rectangular course f. Forced landings	00:15	00:45		01:00	08:45
13	CP-10	(1) Review previous contact work (2) Practice a. Take-offs and landings b. Forced landings		01:00		01:00	09:45
14	IF-10 CP-11	(1) Review and practice a. Basic instrument work b. Take-offs and landings c. Forced landings (2) Demonstrate and practice crosswind take-offs and landings	00:30	00:30		01:00	10:45

(Continued)

Appendix E *(Continued)*

Training Day	Period	Maneuver	Flight Time Hood	Dual	Solo	Period	Cum. Total
15	CP-12	Review and practice a. Previous contact work b. Take-offs and landings		01:00		01:00	11:45
16	CP-13	Review and practice previous contact work		01:00		01:00	12:45
17	CP-14	(1) Review and practice a. Previous contact work b. Take-offs and landings (2) Supervised solo for qualified students		00:30	00:30	01:00	13:45
18	CP-15	(1) Review and practice a. Previous contact work b. Take-offs and landings (2) Supervised solo for qualified students		00:30	00:30	01:00	14:45
19	CP-16	(1) Review and practice a. Previous contact work b. Take-offs and landings (2) Supervised solo for qualified students		00:30	01:30	02:00	16:45
20	CP-17	(1) Review and practice previous contact work (2) Demonstrate a. DF procedures b. Elementary eights c. Area check-out d. Homing		01:00		01:00	17:45
21	IF-11 CP-18	Review and practice previous work	00:30	00:30		01:00	18:45
22	CP-19	Review and practice all contact maneuvers		01:00	01:00	02:00	20:45
23	IF-12 CP-20	Demonstrate and practice a. 360° steep turns b. Steep turn stall (dual only) c. Full power climbing stall d. Power-off gliding turn stall (power recovery) e. Unusual attitude recoveries	00:45	00:15		01:00	21:45
24	IF-13 CP-21	(1) Review and practice previous periods (2) Demonstrate and practice a. Use of magnetic compass (lead & lag, timed turns) b. Elementary eights	00:30	00:30		01:00	22:45
25	IF-14 CP-22	Review and practice previous periods as necessary	00:30	00:30	01:00	02:00	24:45
26	CP-23	Review and practice previous periods as necessary		01:00		01:00	25:45
27	IF-15 CP-24	Review and practice previous periods as necessary	00:30	00:30		01:00	26:45
28	CP-25	Review and practice previous periods as necessary		00:30	01:00	01:30	28:15
29	IF-16 CP-26	Review and practice previous periods as as necessary	00:30	00:30	01:00	02:00	30:15
30	AL-1 IF-17	Accuracy landings, power assist (graded 4 of 5). Review and practice previous periods as necessary	00:30	00:30	01:00	02:00	32:15
31	CP-27	Review and practice previous maneuvers		00:30	00:45	01:15	33:30
32	A-1 CP-28 IF-18	35-hour demonstration ride Review and practice previous maneuvers	00:30	00:30		01:00	34:30

(Continued)

Appendix E *(Continued)*

Training Day	Period	Maneuver	Flight Time Hood	Dual	Solo	Period	Cum. Total
33	IF-19 CP-29	Review and practice previous instrument & contact work as necessary	00:30	00:30		01:00	35:00
34	IF-20 CP-30	Review and practice previous instrument & contact work as necessary	00:30	00:30	00:45	01:45	37:15
35	IF-21 CP-31	(1) Practice all previously authorized solo maneuvers as necessary (2) Demonstrate and practice a. 720° steep turns b. Shallow eights around pylons c. Chandelles	00:30	00:30	01:00	02:00	39:15
36	AL-2	Crosswind landings, power off (graded passing four out of five)			01:30	01:30]	40:45
37	NAV-1	Day navigation (dead reckoning & pilotage) a. Practice in establishing and maintaining a designated track b. Orientation by reference to map and ground objects c. In-flight use of the E-6B computer to include determination of ETA d. Landing at other than home field e. One leg to be low level f. Aural-null procedures g. Precautionary landings		03:00		03:00	43:45
38	CP-32	Practice all previously authorized solo maneuvers as necessary			01:30	01:30	45:15
39	IF-22 CP-33	(1) Review and practice previous maneuvers as necessary (2) Demonstrate and practice a. Sprials (around a point and CS/CB) b. Advanced stall series	00:30	00:30	01:00	02:00	47:15
40	IF-23 CP-34	Demonstrate and practice a. Emergency panel b. 180° overhead approach c. 360° overhead approach	00:30	00:30		01:00	48:15
41	IF-24 CP-35	Review and practice previous maneuvers as necessary	00:30	00:30	00:45	01:45	50:00
42.	NAV-2	Day navigation (dead reckoning & pilotage) a. Practice in establishing and maintaining a designated track b. Orientation by reference to map and ground objects c. In-flight use of the E-6B computer to include determination of ETA d. Landing at other than home field			03:00	03:00	53:00
43	IF-25 CP-36	Review and practice previous maneuvers as necessary	00:30	00:30	01:00	02:00	55:00
44	IF-26 CP-37	Review and practice previous maneuvers as necessary	00:30	00:30	00:45	01:45	56:45

(Continued)

Appendix E *(Continued)*

Training Day	Period	Maneuver	Flight Time				
			Hood	Dual	Solo	Period	Cum. Total
45	NAV-3	Day navigation a. Combine principles of pilotage and dead reckoning with use of radio aids b. Landing at two fields other than home field			03:00	03:00	59:45
46	IF-27 CP-38	Review and practice previous maneuvers as necessary	00:30	00:30	01:00	02:00	61:45
47	IF-28 CP-39	Review and practice previous maneuvers as necessary	00:30	00:30	01:00	02:00	63:45
48	CP-40	Review and practice previous maneuvers as necessary		01:00		01:00	64:45
49	CP-41	Review and practice previous maneuvers as necessary			01:30	01:30	66:15
50	NL-1 IF-29	(1) Review previous maneuvers as necessary (2) Night local a. Take-offs and landings b. Go-around procedures c. Orientation of local area d. Correlating night contact and instrument flight	00:30	01:00	01:00	02:30	68:45
51	NAV-4N	Night navigation a. Correlating night contact and instrument flight b. Application of day navigation procedures to night navigation c. Recognition of check points and determination of position at night d. Use of night navigational aids		02:30		02:30	71:15
52	NAV-5N	Night navigation a. Application of day navigation procedures to night navigation b. Recognition of check points and determination of position at night c. Use of night navigational aids			02:30	02:30	73:45
53	CP-42	Review and practice previous maneuvers as necessary		01:00	00:30	01:30	75:15
54	IF-30 CP-43	Review and practice previous maneuvers as necessary	00:30	00:30		01:00	76:15
55	CP-44	Review and practice previous maneuvers as necessary		01:00	01:00	02:00	78:15
56	A-2 IF-31 CP-45	Review and practice previous maneuvers as necessary 75-hour demonstration ride	00:30	00:30		01:00	79:15
57	IF-32 CP-46	(1) Demonstrate and practice a. Steep eights around pylons b. Lazy eights c. Slips and slipping turns (2) Review and practice maneuvers as necessary	00:30	00:30		01:00	80:15
58	IF-33 CP-47	Review and practice previous maneuvers as necessary	00:30	00:30	01:00	02:00	82:15
59	IF-34 CP-48	Review and practice all maneuvers as necessary	00:45	00:15	00:30	01:30	83:45

(Continued)

Appendix E *(Continued)*

Training Day	Period	Maneuvers	Flight Time				
			Hood	Dual	Solo	Period	Cum. Total
60	IF-35 CP-49	Review and practice previous maneuvers as necessary	00:45	00:15		01:00	84:45
61	CP-50	Review and practice previous maneuvers as necessary			01:30	01:30	86:15
62	IF-36 CP-51	Review and practice all maneuvers as necessary	00:45	00:15		01:00	87:15
63	IF-37 CP-52	Review and practice all maneuvers as necessary	00:30	00:30	01:00	02:00	89:15
64	IF-38 CP-53	Review and practice all maneuvers as necessary	00:30	00:30		01:00	90:15
65	CP-54	Review and practice all maneuvers as necessary		01:00		01:00	91:15
66	CP-55	Review and practice previous maneuvers as necessary		01:00	01:00	02:00	93:15
67	IF-39 CP-56	Review and practice previous maneuvers as necessary	00:45	00:15		01:00	94:15
68	CP-57	Review and practice previous maneuvers as necessary			01:00	01:00	95:15
69	IF-40 CP-58	Wheel landing stage	00:30	00:30		01:00	96:15
70	CP-59	Review and practice previous maneuvers as necessary			01:00	01:00	97:15
71	IF-41 CP-60	Review and practice previous maneuvers as necessary	00:30	00:30		01:00	98:15
72	CP-61	Review and practice previous maneuvers as necessary			01:00	01:00	99:15
73	IF-42 CP-62	Review and practice previous maneuvers as necessary	00:30	00:30		01:00	100:15
74	CP-63	Review and practice previous maneuvers as necessary		01:00	01:00	02:00	102:15
75	IF-43 CP-64	Review and practice previous maneuvers as necessary	00:30	00:30		01:00	103:15
76	IF-44 CP-65	(1) Instrument demonstration ride (2) Review and practice previous maneuvers as necessary	01:00		01:00	02:00	105:15
77	CP-66	Review and practice previous maneuvers as necessary			01.00	01.00	106:15
78	CP-67	Review and practice previous maneuvers as necessary		01:00		01:00	107:15
79	AL-3	Accuracy landing (graded passing four out of five)			01:00	01:00	108:15
80	CP-68	Review and practice previous maneuvers as necessary		01:00		01:00	109:15
81	CP-69	Review and practice previous maneuvers as necessary		01:00	01:00	02:00	111:15
82	CP-70	Review and practice previous maneuvers as necessary		01:00		01:00	112:15
83	CP-71	Review and practice previous maneuvers as necessary			01:00	01:00	113:15

(Continued)

Appendix E *(Continued)*

Training Day	Period	Maneuver	Flight Time Hood	Dual	Solo	Period	Cum. Total
84	A-3	Final contact demonstration ride a. All phase A-2 contact maneuvers b. Steep eights c. Lazy eights d. Slips and slipping turns e. Wheel landings		01:15		01:15	114:30
85	CP-72	(L-19) (1) Familiarization (2) Demonstrate and practice a. Visual inspection and cockpit procedures b. Upper-air work c. Ground track maneuvers d. Take-offs and landings e. Emergency procedures (3) Supervised solo		01:00	00:30	01:30	116:00
86	CP-73	(L-19) (1) Review and practice all previous maneuvers (2) Review and practice authorized solo maneuvers		01:00	01:00	02:00	118:00
87	CP-74	(L-19) (1) Review and practice all previous maneuvers (2) Review and practice authorized solo maneuvers		01:00	01:00	02:00	120:00
88		OUTPROCESSING					

Appendix F

DPR LEARNING CURVES FOR SELECTED PRIMARY FLIGHT MANEUVERS

For purposes of illustrating the changes in daily flight performance over time, the DPR data for four selected primary flight maneuvers are shown graphically. The maneuvers selected are: (a) *Take-off*, (b) *Level Turns*, (c) *Slow Flight*, and (d) *Traffic & Landing*. The performances of the I/SS, NI/SS, and NI-T groups are shown by separate curves. Points plotted on these curves are the *Mean Percent Error* (Figures F-1 through F-4) and *Mean Daily Grade* (Figures F-5 through F-8). In all cases the abscissa represents *total* flight time.

These four maneuvers were selected to represent the most critical portions of a flight, the *Take-off* and the *Traffic and Landing* maneuvers, and to present one relatively simple flight maneuver, *Level Turns*, and one relatively complex airwork maneuver, *Slow Flight*. It will be noted that the curve form for each of these maneuvers is much like that of the classical learning curve for error reduction.

Since there was variation in number of students in each group over time (as a function of attrition from training; see Table 4), the number of performances represented at each five-hour block time plotting point is variable. Consequently, no plots were made beyond the 100-hour level because of the small *Ns*, although the Primary Phase consisted of 120 hours. However, very few of the points plotted for any of the groups represent a number of observations smaller than ten.

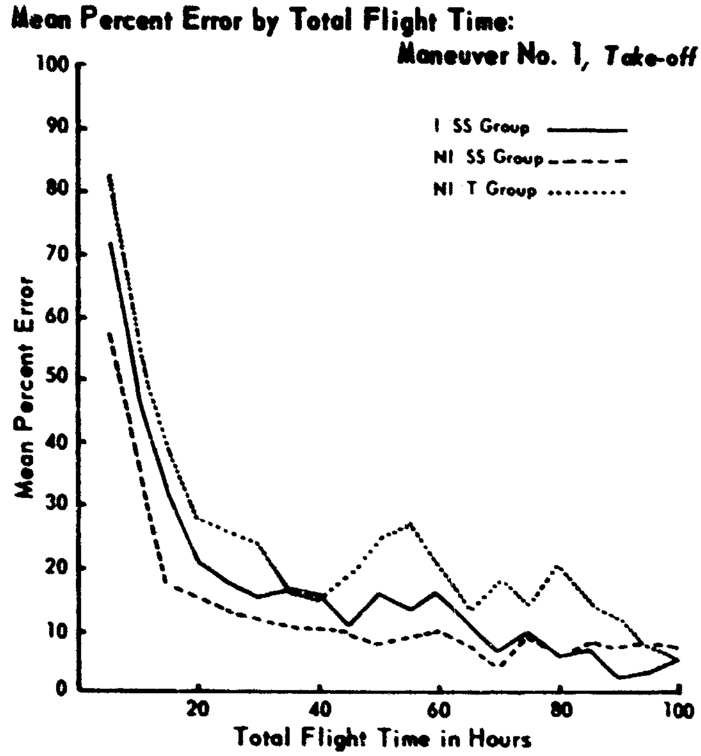


Figure F-1

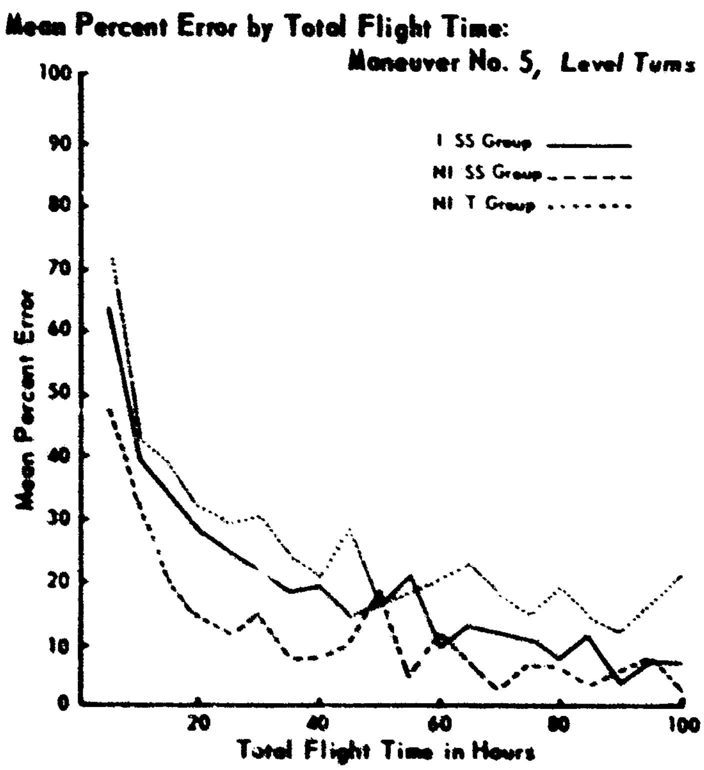


Figure F-2

Mean Percent Error by Total Flight Time:
Maneuver No. 8, *Slow Flight*

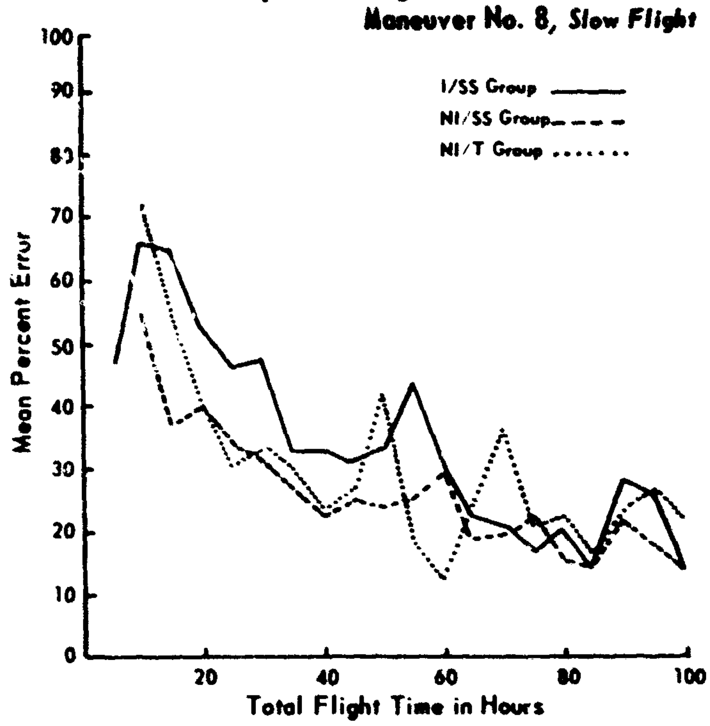


Figure F-3

Mean Percent Error by Total Flight Time:
Maneuver No. 11, *Traffic and Landing*

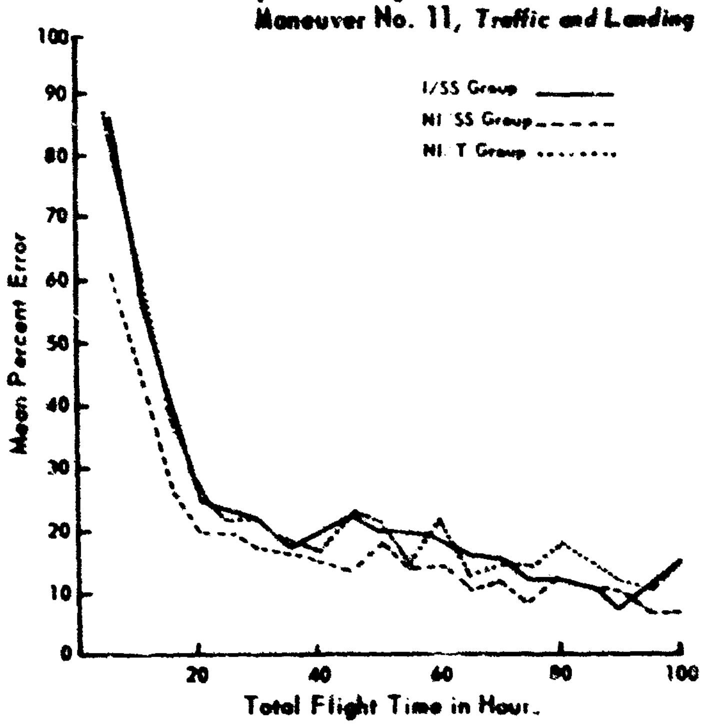


Figure F-4

Mean Daily Flight Grade by Total Flight Time:
Maneuver No. 1, *Take-off*

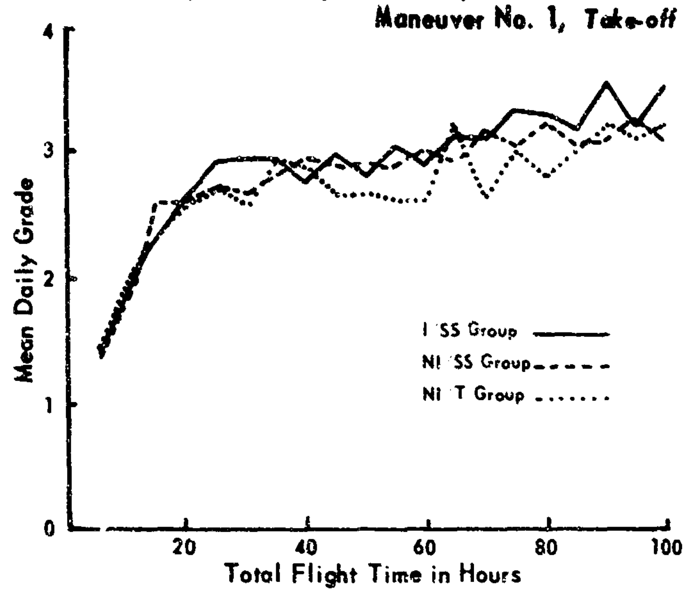


Figure F-5

Mean Daily Flight Grade by Total Flight Time:
Maneuver No. 5, *Level Turns*

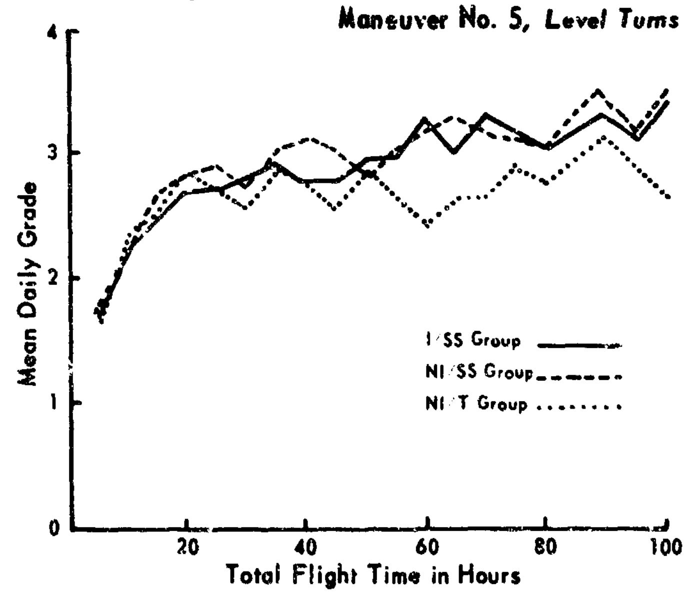


Figure F-6

Mean Daily Flight Grade by Total Flight Time: Maneuver No. 8, *Slow Flight*

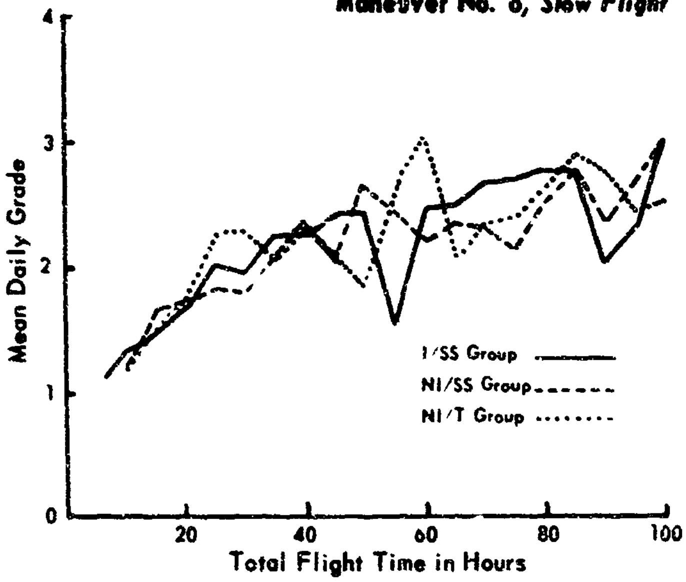


Figure F-7

Mean Daily Flight Grade by Total Flight Time: Maneuver No. 11, *Traffic Landing*

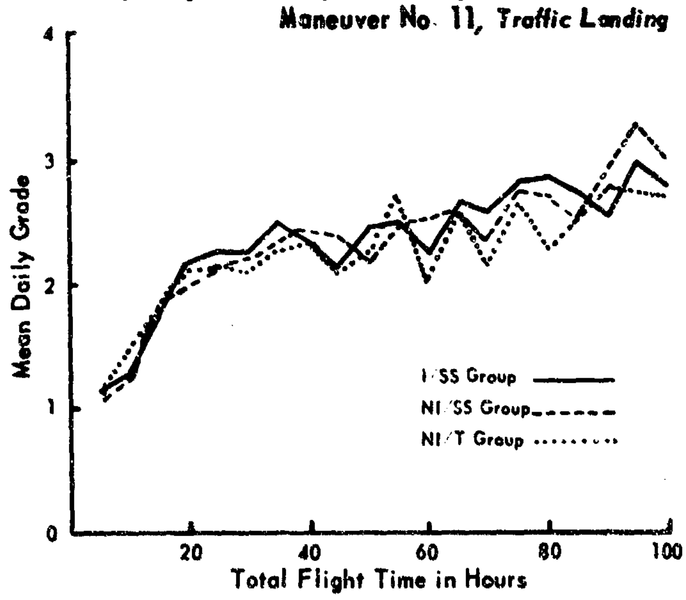


Figure F-8

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13. ABSTRACT

This report describes the results of an experimental comparison of three primary fixed wing flight training methods: (a) integrated contact-instrument primary flight training administered in a side-by-side seating aircraft; (b) non-integrated primary flight training administered in a side-by-side seating aircraft; and (c) non-integrated primary flight training administered in a tandem-seating aircraft.

Three groups of students from two Army primary fixed wing flight classes were administered one of the three methods of instruction cited. Their flight performances in primary (120 hours), advanced contact (80 hours), and advanced instrument (50 hours) training phases were compared utilizing specially developed objective flight performance measures. Results showed differences in favor of the integrated students on checkrides administered at 75- and 120-hour levels during primary training. Differences between integrated and non-integrated students were not significant at the advanced training phase levels. Side-by-side trained students showed advantages over students trained in tandem-seating aircraft in all three phases of training.

It is concluded that: (a) integrated primary training produces gains in primary maneuver flight proficiency; (b) the primary phase advantages of integrated students do not carry over to advanced flight training levels; and (c) students receiving primary training in side-by-side seating show higher flight proficiency than do those trained in tandem-seating aircraft.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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Flight training methods						
Integrated-contact instrument training						
Instrument flight training						
Primary flight training						
Training aircraft						
Training methods						

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